THE ECONOMIC VALUE OF BIODIVERSITY FOR LOCAL LIVELIHOOD IN AND AROUND SIMIEN MOUNTAINS NATIONAL PARK, ETHIOPIA: APPLICATION OF NON-MARKET VALUATION METHOD

M.Sc. Thesis

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JUNE, 2017

GONDAR, ETHIOPIA

UNIVERSITY OF GONDAR
COLLAGE OF AGRICULTURE AND RURAL TRANSFORMATION
DEPARTMENT OF AGRICULTURAL ECONOMICS

The Economic Value of Biodiversity for Local Livelihood in and Around Simien Mountains National Park, Ethiopia: Application of Non-Market Valuation Method

By

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A Thesis Submitted to the Directorate of Graduate Studies of University of Gondar, In Partial Fulfillment of the Requirements for the Degree of Masters of Science in Agricultural Economics

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June, 2017
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DEDICATION

This thesis is dedicated to my families who gave me what I want in my career and this work.

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ACKNOWLEDGEMENT

First and foremost I would like to thank my Almighty God for all. Next I would like to give my utmost gratitude to Akalu Teshome (PhD) and Abebe Dagnew (Assistant Professor) for their kind support and friendly approach. It was great to have you both as my advisors and I can say that I was lucky being advised by you. Thank you for your time and valuable guidance/advice, comments and suggestion in due-course.

I would like take this opportunity to thank data enumerators who dedicated their time in gathering all the first hand data from respondents. My thanks go to respondents for their valuable time and patience in providing such importance evidence. I would like also to thank Tefera Berihun (PhD candidate) who gave me LIMDEP 8 NLOGIT 3 econometric software which helped me greatly. It was almost impossible to get the software as it is not free download software. s

My gratitude will also go to my friend who helps me in data encoding and encouragement. Things were impossible without my families' love and unreserved support all the ways I came from, thank you so much my lovely wife, Meseret Mehabaw and my angle son, Nehemiya Misganaw, for your love, courage and unreserved support.

ACRONYMS AND ABBREVIATIONS

a.s.l.	Above Sea Level
ACM	Advisory Committee Member
ADO	Agricultural Development Office
ASC	Alternative Specific Constant
BIOECON	Biodiversity and Economics
CART PGC	College of Agriculture and Rural Transformation Post Graduate Committee
CBA	Cost-Benefit Analysis
CBD	Convention on Biological Diversity
CE	Choice Experiment
CGS	Council of Graduate Studies
CGS	Council of Graduate Studies
CS	Consumers Surplus
DFERA	Department for Environment, Food and Rural Affairs
DGC	Departmental Graduate Committee
DPGC	Department of Post Graduate Committee
EGS	Ecosystem Goods and Services
EIBC	Ethiopian Institute for Biodiversity Conservation
EIBCR	Ethiopian Institution of Biodiversity Conservation and Research
EPA	Environmental Protection Agency
EPE	Environmental Policy of Ethiopia
EVRI	Environmental Valuation Research Inventory
EWCA	Ethiopian Wildlife Conservation Authority
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GMP	General Management Plan
HHs	Households
IGA	Income Generating Activities
IIA	Independence of Irrelevant Alternative
I**ID**	Independently and Identically Distributed
IRISH-AID	Irish Aid for International Development
KAs	Kebele Administrations
LIMDEP	Limited Dependent Variables

MA	Millennium Assessment
MDG	Millennium Development Goal
MEA	Millennium Ecosystem Assessment
MNL	Multinomial Logit
MSc.	Master of Science
MWTP	Marginal willingness to Pay
NLOGIT	Nominal Logit
ÖBf	OSTERREICHE BUNDESFOREST AC (German Consulting Company)
OECD	Organization for Environmental Conservation of Diversity
PhD	Philosophy of Doctor
PSNP	Productive Safety Net Programme
RPL	Random Parameter Logit
RUM	Random Utility Maximising
SDC	Sustainable Development Commission
SDPASE	Sustainable Development for Protected Areas System in Ethiopia
SMNP	Simien Mountains National Park
TEEB	The Economics of Environment and Biodiversity
UNEF	United Nations Emergency Force
UNEP	United Nations Environmental Programme
WEHAB	Water, Energy, Health, Agriculture and Biodiversity
WRI	World Resource Institute
WTA	Willingness to Accept
WTP	Willingness to Pay
WWF	World Wide Fund for Nature

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ABSTRACT

The Economic Value of Biodiversity for Local Livelihood in and Around Simien Mountains National Park, Ethiopia: Application of Non-Market Valuation Method

Simien Mountain National Park (SMNP) is one of the world natural heritages inscribed because of its endemic mammals, beautiful landscape and endowed natural resources with rich biodiversity. Though SMNP is under in the list of endanger natural resource by world heritage committee still it has significant importance and it is a source of use and non-use values. However, due to human induced problems its value is deteriorating from time to time. In addition to the degradation, the economic value of biodiversity is not known as there are little or no studies. Thus, this study is highly helpful to estimate the economic value and the contribution of biodiversity for improving the local livelihood in and around SMNP. In doing so, this study employed choice experimental valuation method to estimate and analyze the economic value of biodiversity using four biodiversity attributes namely fauna and flora, ecosystem services, tourism facilities and infrastructural development and monetary payment. To address the objective of the study, primary data were collected from 203 respondents by identifying four biodiversity attributes using five choice sets each and 1015 total observations. The collected data were analyzed using LIMPED8.0 NLOGIT3.0 econometric software. The descriptive result of the study revealed that 89.2% of the respondent perceived that there is high biodiversity degradation in the area. According to the respondents response major biodiversity loss causes are agricultural encroachment, deforestation and overgrazing. As a result of biodiversity loss 34.5% of the respondent believes that agricultural production and productivity reduced from time to time and affected by climate change adverse effects. As a result the local community shifts their livelihood options from agriculture to other income sources. Though there is high biodiversity degradation in the study area, the establishment of SMNP helps to reduce socioeconomic and livelihood vulnerability of the local community, 94.5% of the respondent believes vulnerability reduced after the establishment of the national park. This is because the local community started to benefit through tourism services, job opportunities, infrastructural facilities and moderated climate. To estimate the values of biodiversity in monetary terms, multinomial logit models and random parameter logit were used to analyze the data collected. From the result of the analysis marginal willingness to pay and welfare impact of the respondent was estimated. All the attributes were significant in affecting the probability of choosing alternative scenarios and had the expected sign. The result of the study revealed that local community is willing to pay birr 587.03, 391.62, and 195.41 Birr annually for high impact, medium impact and low impact scenarios respectively. Moreover, the estimated compensating surplus (welfare) for low impact improvement scenario, medium impact improvement scenario, and high impact improvement scenario were 7,930,457.50, 15,886,470.95 and 23,812,871.95 Birr per year, respectively. Therefore, it is advisable to take action in improving the status of biodiversity of SMNP and it buffer zone for the sake of welfare improvement of the society in particular and for its significant value for the globe in general.

Key Words: Choice experiment, Economic Value of Biodiversity, Marginal Willingness to Pay, Compensating Surplus, Welfare, Economic Valuation.

1. INTRODUCTION

1.1. Background

Biodiversity is important to humans for various reasons. In economic terms, we can think of this as contributing to different elements of "Total Economic Value", which comprises both use and non-use values, Department for Environment, Food and Rural Affairs (DEFRA, 2008). Biodiversity played tremendous role in sustaining human being's life through ecosystem service provision and maintaining the ecology to be comfortable for human being to live. Biodiversity offers multiple opportunities for development and improving human well-being.

For humans, biodiversity provides many key benefits, including food security, reduction of vulnerability to natural disasters, energy security, and access to clean water and raw materials (GreenFacts, 2005). Biodiversity is fundamental for the sustainability of current and future human livelihoods (Gatzweiler, 2006). By ensuring proper functioning of ecosystems that generate a stream of ecosystem goods and services, biodiversity is seen as essential to human wellbeing (Costanza, 2007).

According to Shah (2014) at least 40% of the world's economy and 80% of the needs of the poor are derived from biological resources. In addition to, the richer the diversity of life, the greater the opportunity for medical discoveries, economic development, and adaptive responses to such new challenges as climate change.

The World Resources Institute (WRI, 2005) report demonstrates that rural households derive a significant share of their total income from ecosystem goods and services. At the global level, the WRI estimates that 1.6 billion people depend on forest ecosystems in some way for their environmental income. According to Wunder, 2014, overall natural forests provide 21.1% of total household income (another 1% coming from forest plantations); 6.4% is derived from non-forest environments (fallows, bush, grasslands, etc.), making the combined environmental income 27.5%.

Christie (2006), mentioned that almost all countries of the globe especially less developing countries depend on biodiversity in one way or another; poor people depend on biodiversity as a direct contribution to their subsistence, income and other livelihood needs, and as a source of risk coping and insurance.

Likewise, biodiversity provides free of charge services worth hundreds of billions of Ethiopian Birr every year that is crucial to the wellbeing of Ethiopia's society. Almost 85% of the population in Ethiopia live in rural areas, and a large part of this population depends directly or indirectly on natural resources. Thus, biodiversity has direct linkage with poverty, sustainable development, local livelihood improvement, income generation, and many more in both developing and developed nation of the globe, Ethiopian Institute of Biodiversity Conservation (EIBC, 2016).

Thus, economic valuation of biodiversity is important since it provides a useful vehicle to highlight and quantify the range of benefits delivered by biodiversity. Importantly, placing monetary values on biodiversity and its ecosystem services will bring biodiversity into a common currency for use in decision-making, allowing its benefits to be directly compared with other development trajectories (Christie, et al., 2008).

However, there are no many studies on the economic value of biodiversity studied to explicitly elicit its total economic value especially in less developing countries of the world.

According to Department for Environment, Food and Rural Affairs (DEFRA) biodiversity valuation studies reviewed in 2008, searches of Environmental Valuation Research Inventory (EVRI) database retrieved from (http://www.evri.ca/), 1686 studies (written in English) that valued biodiversity were identified. Of these studies, 1487 (88.4%) were from high income or upper middle income countries and 195 (11.5%) were from developing countries. Of those studies conducted in developing countries, 94 (5.6%), 101 (5.9%), 0 (0%) studies were from lower middle, lower income, and countries with transitional economies, respectively. From these studies conducted in developing countries, 48% were in Asia, 17% in Africa and 6% in South America (DEFRA, 2008).

The above review shows that there is a huge gap of economic valuation of biodiversity in developing countries especially in Africa.

In Ethiopia as per our search knowledge, there is no or little attempts have been made to know the total economic value of biodiversity and its role for local livelihood. However, attempts have been made to know the benefit of different ecosystems (such as mountain and wetland ecosystem), importance of ecotourism sites, recreational value of parks and other wetland ecosystem using different environmental valuation methods.

The economic value of biodiversity of Simien Mountains National Park (SMNP) and its buffer zone is not been yet studied, except few studies which focus on recreational value and ecotourism site value of the mountain, Walia idex [1]conservation, and some willingness to pay for conservation practices using contingent, experimental and travel cost valuation methods.

However, all the studies didn't try to know the total economic value of biodiversity and its role for the local livelihood enhancement in the study area. Thus, due to this valuation problem, it is difficult to estimate the annual economic value of biodiversity as well the total economic value of biodiversity for Gross Domestic Product (GDP) in Ethiopia in general and in the study are in particular.

Thus, the major objective of this study is to estimate economic value and contribution of biodiversity for the local livelihood enhancement for people who lives in and around SMNP and its buffer zone using choice experimental valuation method.

This study has also importance to indicate socioeconomic factors of biodiversity loss and the coping mechanism of the local community to overcome the negative efforts of biodiversity loss.

1.2. Statement of the Problem

Currently available literatures explained that the economic value of biodiversity for human wellbeing is vital. To know exactly how important it is in the economy different valuation method have been employed by different researchers and institutions such as The Economics of Environment and Biodiversity (TEEB) and Department for Environment, Food and Rural Affairs (DEFRA).

Biodiversity of SMNP and its surrounding is source of life supporting ecosystem services for both people living in and around the national park and for people living downstream of its catchment.

The Simien Mountains National Park General Management Plan (GMP, 2009), states that in addition to the valuation gap, biodiversity loss is also one of the greatest threats of the national park. Most of the threats of SMNP are human induced such as increase population of human and domestic animals, agricultural encroachment, deforestation, land degradation, climate change and decreased number of flagship mammals (GMP, 2009). Due to these

[1] Walia Ibex is a type goat that live 2500-4500M ups the steep cliffs of the Ethiopian highlands in SMNP and nowhere else in the world.

human induced threats and other challenges of the national park, world heritage committee inscribe the national park as one of the endangered natural heritage site in the world since 1996.

According to Ethiopian institute for biodiversity conservation (2011), poor people, women, and marginalized communities are highly vulnerable to biodiversity loss impacts. Thus, in order to secure their livelihoods, it is imperative that biodiversity loss issues be addressed as a key development concern.

It is clear that to restore and conserve biodiversity losses of any ecosystem; it is highly important to know exactly how much the local community is willing to pay for conservation or willing to accept for compensation.

As it has been mentioned above, even though the biodiversity of SMNP has significant importance for the local livelihood enhancement in many ways, its role and economic value studied little. Some studies have been conducted regarding the SMNP ecosystem and its recreational value using travel cost, contingent valuation methods, and choice valuation methods, ex, valuing conservation of walia ibex: an application of choice experiment valuation method, an analysis of economic valuation through contingent valuation method in Simien mountains national park (SMNP), Ethiopia, valuing the economic benefit of ecotourism areas with travel cost and choice experiment methods: a case study of semen mountain national park, Ethiopia" . However, all these studies focus only on the importance of tourism and tourism related roles of SMNP, but not about the role of biodiversity for other regular community who has no involvement on tourism activities.

Therefore, it is highly difficult to know exactly how much the local community will be affected due to biodiversity loss as there is no or very little study on the economic value of biodiversity in the study area. On top of this, it is difficult to estimate how the local community is suffering from food insecurity problem, affected by climate change and forced to change livelihood options because of biodiversity loss. Due to this limitation of studies in the sector, it was unable to design appropriate coping mechanism for the risk and vulnerability of local community and also unable to suggest appropriate conservation strategy regarding biodiversity.

Even though biodiversity is highly important for the people who live in and around the national park, its role and economic value is not yet studied in depth.

Given this background, this empirical study estimate the economic value of biodiversity for local livelihoods enhancement in and around SMNP using choices experimental valuation method by selecting specific biodiversity attributes. This study is quite different than other similar studies conducted in the study area. Some studies conducted in and around SMNP were focused on ecosystem valuation in general instead on biodiversity as particular issue using contingent and travel cost methods. Therefore, this study is different from other similar studies in both valuation method used as well issues going to be addressed. The study also helps to know the socioeconomic factors of biodiversity loss and the local communities' coping mechanism/livelihood strategies during slack time.

1.3. Objective of the Research

To design an appropriate conservation strategy it is good to know the economic value (market and non-market value) of biodiversity. To do so the following general and specific objectives have been designed for this study. These objectives can capture the importance of biodiversity for local livelihood, poverty reduction, food security and other non-use values and the amount of use values.

1.3.1. General Objective

The major objective of the study is to assess and estimate the economic value of biodiversity for the livelihoods of people who live in and around SMNP, Amhara Regional State, North Gondar Zone, Ethiopia.

1.3.2. Specific objectives

In addition to the general objective, this study aims to assess the following specific objectives:

- To identify socio-economic characteristics which aggravate biodiversity loss,
- To assess livelihood strategies of the local communities for improving and securing their livelihoods and conserving biodiversity in the study area.
- To estimate the economic value of biodiversity for local livelihood in and around SMNP using scenario based analysis,

1.4. Research Questions

The main research question to be answered is:

- What are the economic values of the biodiversity for livelihood opportunities of the local communities living in and around SMNP?

Sub questions to the question above are the following:

- How are the communities formerly living in and around the National Park affected due to the establishment of the national park?
- How does current socioeconomic vulnerability compare to past socioeconomic and livelihood vulnerability for communities in and around SMNP? (In relation to loss of access to common property and social disarticulation using community simple comparison on qualitative base),
- How is the local community willing to conserve and/or participate in the conservation efforts of the national park? (In relation to community contribution conservation, willingness to relocate, willingness to accept compensation etc those who are inside the national park and around its buffer zone).

1.5. Significance of the research

Biodiversity has significant importance to the livelihood of the local community who live in and around the protected areas. However, the economic value of most protected areas and/or national parks in Ethiopia is not properly studied. Few studies on the importance of some ecosystems and wetlands have been studied by different researchers. However, these studies were focused on specific ecosystem and the value of that ecosystem but not about the economic value of biodiversity for household economy in the ecosystem in particular.

Therefore, this study enable to know the economic value and the role of biodiversity for improving the local community livelihood who lives in and around the national park and most importantly it is important to know the relation of biodiversity and local livelihood in and around the national park/protected areas.

This study also helps to understand determining factors of biodiversity loss in and around protected areas, and also lend a hand to estimate how much the local community is affected by biodiversity losses and how they cope up with.

This empirical study could help to design strategies to address determinants and its associated factors of biodiversity loss in and around protected areas through integrated intervention strategy.

It will also help to identify local livelihood opportunities and their correlation with biodiversity in and around protected areas which could help to promote most environmentally friendly and most feasible livelihood options in the study area.

Moreover, this research could become a reference for those who want to study determining factors of biodiversity loss as well the contribution of biodiversity for local livelihood opportunities in and around SMNP in particular and it can be serve as a spring board for national level policy makers and researchers regarding protected areas.

1.6. Scope and limitation of the research

1.6.1 Scope of the study

Due to limitation of resources and time only four attributes were used in choice experimental model. This might limit the finding of the research and unable to compare the result with other valuation method. Moreover, the study covered only four districts namely Debark, Debark Zuria, Janamora, and Beyeda, rather than including all districts in North Gondar Zone of the region. In addition to this, only 203 respondents were interviewed out of 9508 HHs from 9 KAs.

However, the recommendation and/or suggestion generated from the study could provide adequate information for policy makers to design national wide polices in relation to biodiversity and its multifaceted economic effect on local community. In addition the result of this research would have an important implication for different development actors in protected areas system in Ethiopia especially areas with similar ecological zone.

1.6.2 Limitation of the study

Even though the role and importance of biodiversity is significant in developing countries, the economic value of biodiversity and its role in less developed nations like Ethiopia has not been studied well. It was difficult for this research to get literatures and other reference under the research topic and/or related works focused on the study area. Thus, this could be difficult to compare results of the study with other findings.

Though other related studies are limited, to achieve the objectives of this study, different primary and secondary data were collected from different sources. However, due to unavailability and/or limitation of adequate secondary data (especially time series data) in addition to the involuntariness of the respondents to provide more relevant information, this

study might have limitation. Moreover, since the primary data were collected using local units of measurement, some errors might happen when converted into international units. The biasness of the respondent because of fear of taxes and other government obligations may also reduce the accuracy of investigation.

In addition to the above general limitation, the following specific limitation might affect the findings of this study.

- The perception of the respondents regarding the importance of biodiversity and it role for livelihood improvement,
- Respondents limited knowledge and experience of estimating the monetary value of biodiversity and other complex environmental good and services,

Despite all these limitation, maximum effort was exerted to make the study plausible and useful as a spring board for other researchers and policy makers.

1.7 Organization of the Paper

This research paper has been organized in five main chapters. The introduction and background, objective of the research, statement of the problem, scope, limitation and research question have been detailed in the first chapter. The following chapter (chapter two) of this paper tried to cover the literature review part of the research which covers theoretical framework, concept of biodiversity, valuation of environmental resources and more importantly the empirical literature of the existed knowledge about the research topic.

The third chapter of this paper discuss about data and research methodology employed in this research. In this chapter the study area, the type and sources of data, sampling technique and sampling size, choice experimental valuation method and econometrics model specification have been discussed. In addition to this, choice experiment design procedure and steps have been discussed in this chapter. The empirical result findings, discussions and summary, conclusion and recommendation are detailed in chapter four and five, respectively.

2. LITERATURE REVIEW

In this section current knowledge available about the research topic has been reviewed from different sources. However, there are no similar studies conducted in the study area and/or in Ethiopia, the review focused on world available knowledge from different search engines.

2.1. Theoretical Framework and Concept of Economic Value of Biodiversity

As biodiversity encompass life supporting living organisms, thus, biodiversity loss will threaten the wellbeing of human being and therefore conserving the Mother Nature is becoming one of the development strategies of the world community. Therefore, biodiversity and biodiversity conservation is currently become priority concern of all the nations in both developed and developing nations to get ecosystem services for the sustenance of the community. Conceptually everything is just connected and biodiversity is all the different life of earth and from the diverse biology human being obtained different ecosystem services. Therefore, to sustain these ecosystem services it might need to adopt more suitable, economical and community based conservation approach. As it is a complex concept rather than a single physical entity, biodiversity cannot be captured 'directly', but only by use of proxies or indicators. Accordingly, economic valuation studies that aim to assign a value to biodiversity choose very diverging approaches and use different proxies to approximate this inherently abstract and complex concept (Meinard and Grill, 2011).

Biodiversity is often believed to be economically valuable, but it is unclear where its value stems from. To date, a number of economic valuation studies targeted biodiversity in highly diverse ways, yet there exists no consistent framework for valuing it (Bartkowski, 2016).

In this part the concept of economic value of biodiversity and it theoretical framework are reviewed and discussed. In addition to this, importance of biodiversity and its role in the wellbeing of human being discussed based on the current literature.

2.1.1 Concept of biodiversity

Biodiversity may be described in terms of genes, species, and ecosystems, corresponding to three fundamental and hierarchically related levels of biological organization (Preace, *et al*., 2014).

Biodiversity reflects the hierarchy of increasing levels of organization and complexity in ecological systems at different levels i.e., genes, individuals, populations, species, communities, ecosystems and biomes. It is communities of living organisms interacting with the abiotic environment that comprise, and characterize, ecosystems. Ecosystems are varied both in size and, arguably, complexity, and may be nested one within another (Bharker *et al*., 2010).

Biological diversity, abbreviated to biodiversity, refers to the variety of life forms at all levels of organization, from the molecular to the landscape level. It can be described as the totality of genes, species, and ecosystems within a region. The wealth of life on earth today is the product of hundreds of millions of years of evolutionary history. Over the course of time, human cultures have emerged and adapted to local environments, discovering, using, and altering their biotic resources. Many areas that now seem "natural" bear the marks of millennia of human habitation, crop cultivation, resource harvesting, and waste production. The domestication and breeding of local varieties of crops and livestock have further affected biodiversity (Dale, 2014).

For convenience, biodiversity can be divided into three hierarchical categories: genes, species, and ecosystems. Genetic diversity refers to the variation of genes within species, species diversity is the variety of species within a region, and ecosystem diversity is communities and ecosystems, their number and distribution (Ibid). Biodiversity underpins the essential goods and services that ecosystems provide and has value for current uses, possible future uses (option values), and intrinsic worth (UNEP, 2010).

2.1.2. Economic Importance of Biodiversity

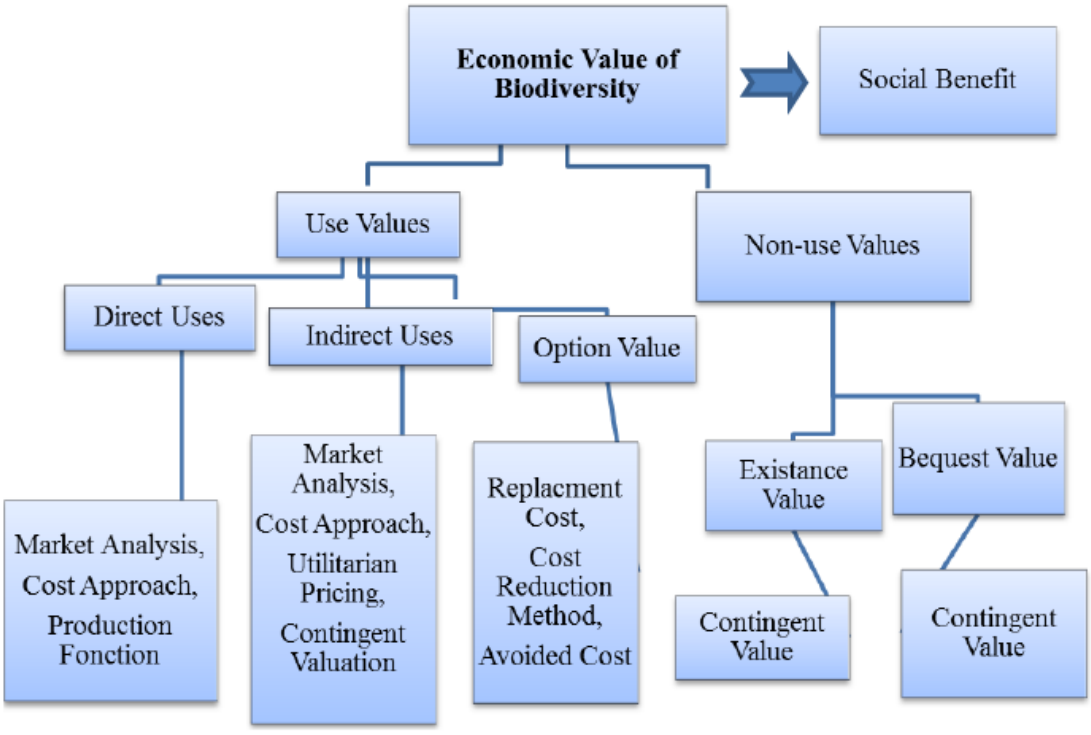
Biodiversity has tremendous importance for human being in many ways especially to get majority of the ecosystem services. Biodiversity may play three different roles in ecosystem services: as a regulator of ecosystem processes, as a final ecosystem service or as a good (Mace *et al*., 2012).

According to Irish Aid (2016) biodiversity provides humanity with various goods and services whose value is rarely factored into policymaking, in part because it is hard to quantify benefits in financial terms. Biodiversity and ecosystem services are essential to the productivity of agriculture, forests, and fisheries. According to Millennium Development Goal (MDG1), ecological goods and services enable people to derive livelihoods and incomes from natural and managed landscapes. Biodiversity is the source of 'ecosystem goods and

services', ranging from food, building materials and medicines to climate regulation and clean water supplies (IRISH-AID, 2016).

The natural environment can be thought of as a spider's web: it is intricately connected at many levels, and often plays multiple roles through the goods and services provided by natural assets. The values that we place on these natural assets are intrinsically linked to the natural environment and can vary across society's needs and wants. Varying uses of the natural environment are often conflicting and provides a challenging context in determining, which values are worth the most the built environment is highly valued to provide shelter, sustenance (food and water), transport and access, safety, health care, protection of property, education, trade opportunities, electricity and social needs. Civilisation's survival has direct dependence on the built environment and its assets and many societies place expectations on what infrastructure and services should be provided (Kirkpatrick, 2011).

Figure 1: Methodological approach for valuation of biodiversity



Source: Adopted from Demir, 2013

The table above presents the methodological approach of biodiversity valuation using indirect valuation non-market valuation method. It tried to address both use and non-use values of biodiversity and social benefits of biodiversity.

The importance of biodiversity is tremendous; each and every species has a particular function in an ecosystem. Some species can capture energy in various forms, ecosystems contribute to improving the production of resources, and some also carries real services such as purifying the air and water, moderating the climate and controlling the rain or drought, and other environmental disasters. Obviously all these important functions are fundamental for human survival. The more varied the ecosystem is, i.e. the greater the biodiversity, the greater its resistance to environmental stress will be. Biodiversity is like a large tank, from which humans can draw food, pharmaceutical products and even cosmetics. Biodiversity is an "assurance" for life on our Planet, and therefore must be protected at all costs, because it is a universal heritage that can offer immediate advantages to human beings. The economic importance of biodiversity for humans can be summarized as follows: Biodiversity offers food, fundamentally important in medicine, has a remarkable role also in the textile fibres manufacturing industry, a source of richness also in the sector of tourism and recreational activities etc (www.eniscuola.net).

Table 1: Ecosystem services from the Millennium Ecosystem Assessment framework

Category	Description
Provisioning Services	Products obtained from ecosystems e.g. food, fuel, materials for building.
Regulating Services	Benefits obtained from the regulation of ecosystem processes e.g. climate regulation, water purification.
Supporting Services	Those are necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people.
Cultural Services	Non-material benefits people obtain from ecosystems and landscape through spiritual enrichment, reflection, recreation, and aesthetic experiences. Also includes the value that people place on the existence of plant and animals.

Source: (DEFRA, 2008)

The table above detailed the summary type of ecosystem services for human being. According to the table ecosystem has provision services, regulating services, supporting services, and cultural services.

However, degradation and biodiversity loss has become a major threat for human being to obtain ecosystem services sustainably. Poor people often depend directly on such goods and services on a daily basis for subsistence or income. The poor are therefore most affected when environments are degraded and biodiversity is lost, as this diminishes the quality and quantity of goods and services available to them (richer people can often afford substitutes) (IRISH-AID, 2016).

Though biodiversity degradation is high and its effect is significant it is still important for human being for its irreplaceable values obtained from ecosystem goods and services. According to Millennium Ecosystem Assessment, global sales of products derived from genetic resources (pharmaceuticals, botanical medicines, major crops, horticulture, crop protection products, cosmetics and personal care products, and a broad range of biotechnologies) lie between U.S. $500 and U.S. $800 billion a year, (MA, 2006).

2.2 Valuation of Environmental Resources

Environmental economic valuation is used to place a value on the goods and services provided by the natural environment (Kirkpatrick, 2011).

The environment can be valued monetarily with the following three distinct groups of techniques: revealed preference, stated preference, and direct market valuation techniques. Direct market valuation techniques are divided into the market price (the monetary value of goods and services that can be bought and sold in commercial markets) and their production function (an estimate of the contribution of a certain ecosystem service to the production of other marketable good) (Bertram and Rehdanz, 2013).

Earth ecosystems provide valuable services supporting human life. Since before the development of agriculture, thousands of years ago, they have been modified and managed to satisfy human’s needs and desires. It does not imply that they can or have to be economically valued, and the quantification and economic valuation of economic services remain controversial (Sagoff, 2011).

The concepts and methods to value ecosystems and biodiversity have progressively emerged and their roots can be found in the core of economic theory of value (Gomez-Baggethum *et al.*, 2010).

2.2.1. Valuation of biodiversity

Estimating the value of the various services and benefits that ecosystems and biodiversity generate may be done with a variety of valuation approaches. All of these have their advantages and disadvantages (TEEB, 2010).

According to neoclassical economic theory, market prices are usually an adequate reference for the value that society places on goods and services. If a good or service has value, an individual will be willing to pay to acquire it or to accept compensation for its loss or damage (Kirkpatrick, 2011).

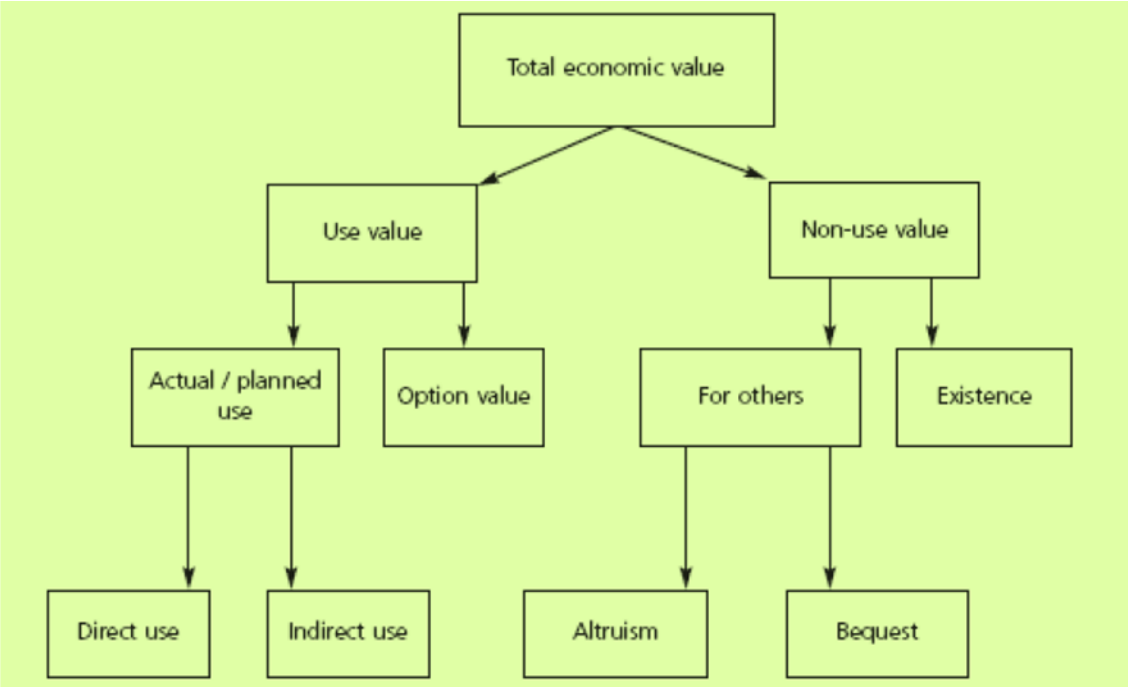
Assigning monetary values to biodiversity is important since it allows the benefits associated with biodiversity to be directly compared with the economic value of alternative resource use options. Failure to do this may result in a loss of biodiversity and their associated ecosystem services. For example, a recent UN report concluded that much of the 20 million square kilometres of land and sea designated within some form of protected area are currently not being effectively managed (UN, 2007).

The valuation of biodiversity is clearly an important step to recognizing the importance of biodiversity to people and bringing biodiversity into the realm of decision making and politics. However, research into the valuation of biodiversity in developing countries is in its infancy and further research effort is required (DEFRA, 2008).

In recent years there has been considerable research undertaken to examine how people value biodiversity (Christie *et al.*, 2007). The majority of these works have been conducted in the developed world; with only limited application in developing countries (Beukering *et al.*, 2007). There are, however, a number of significant challenges associated with valuing biodiversity using available environmental economic techniques in a developing country context. These challenges include low literacy levels; the high reliance on subsistence economies; lack of local research capacity; lack of capacity to build awareness of importance of biodiversity; high cultural diversity; and strong spiritual and cultural values associated with biodiversity. Such problems may mean that a distorted picture of the value of biodiversity could be presented for developing countries if inappropriate methods are used, resulting in

reduced efficacy of resource allocation and policies for poverty alleviation and biodiversity conservation. The use of non-economic techniques (such as questionnaires, focus groups, participatory appraisal approaches) to assess the importance of biodiversity has been suggested as a possible way to address some of these issues. However, it is not clear how these techniques can best complement economic approaches to elicit values and provide meaningful results that can inform policy at national and international levels (DEFRA, 2008). An assessment of the contribution of biodiversity to people's welfare and livelihoods should, ideally, be considered within the following TEV framework.

Figure 2: The elements of Total Economic Value



Sources: Adopted from DEFRA, 2008.

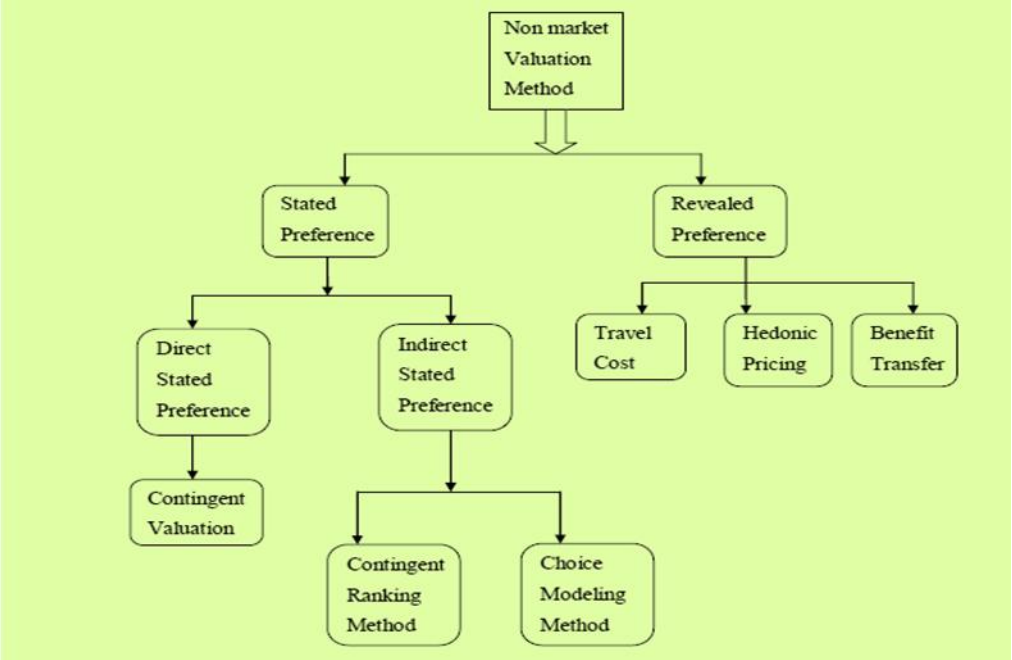
The figure above tried to summarize total economic value of biodiversity and its contribution and role for human welfare and livelihoods.

2.2.2. Classification of Valuation Techniques

Economic valuation of biodiversity is important since it provides a useful vehicle to highlight and quantify the range of benefits delivered by biodiversity. Importantly, placing monetary values on biodiversity and its ecosystem services will bring biodiversity into a common currency for use in decision-making, allowing its benefits to be directly compared with other development trajectories (DEFRA, 2008).

Market for many natural resources, if it exists, cannot reflect or capture all the benefits and costs of using the resource. Thus, ecosystem valuation can be a difficult and controversial task, and economists have often been criticized for trying to put a "price tag" on nature. However, agencies in charge of protecting and managing natural resources must often make difficult spending decisions that involve tradeoffs in allocating resources. These types of decisions are economic decisions, and thus are based, either explicitly or implicitly, on society's values. Therefore, economic valuation can be useful, by providing a way to justify and set priorities for programs, policies, or actions that protect or restore ecosystems and their services retrieved from (http://www.ecosystemvaluation.org/1-02.htm).

Figure 3: Types of Valuation Techniques



Sources: Perman *et al*., (2003)

The above figure detailed non-market valuation method for biodiversity and environmental resources. There is a wide range of methods to estimate the monetary value of natural and environmental resources. Here detailed a brief overview of some important methods used. Basically the methods can be subdivided into two categories: - methods that somehow link the change in an environmental or natural resource, to a market price that can be observed in reality (so called "revealed preferences"); methods that determine preferences directly from consumers, by using various types of questionnaires ("Stated preference techniques") (Jantzen, 2006).

2.2.2.1. Revealed Preference Method

Revealed preference methods uncover estimates of the value of non-market goods by using evidence of how people behave in the face of real choices. The basic premise of the hedonic pricing revealed preference method, for example, is that non-market goods affect the price of market goods in other well-functioning markets. Price differentials in these markets can provide estimates of Willingness to Pay (WTP) and Willingness to Accept (WTA).

Revealed preference techniques are based on the observation of individual choices in existing markets that are related to the ecosystem service that is subject of valuation. In this case it is said that economic agents "reveal" their preferences through their choices (TEEB, 2010).

Revealed preference (RP) methods differs from stated preference (SP) methods in that they use their data people's actual behaviour in real markets, rather than their conjectured behaviour in hypothetical markets. However, the behaviour in the study occurs in markets which are only related to the environmental good in question: they do not exist for the environmental good, since by definition it is considering on-market values here. For this reason, RP methods are sometimes known as indirect methods, since the analyst has to infer the value people place on non-market good indirectly from their behaviour in a market somehow related to that good. This method includes the travel cost method and hedonic pricing techniques (Dawit, 2014).

Kontoleon and Pascual (2007) mentioned some of the limitations of revealed preference method. In revealed preferences methods, market imperfections and policy failures can distort the estimated monetary value of ecosystem services. Scientists need good quality data on each transaction, large data sets, and complex statistical analysis. As a result, revealed preference approaches are expensive and time-consuming. Generally, these methods have the appeal of relying on actual/observed behaviour but their main drawbacks are the inability to estimate non-use values and the dependence of the estimated values on the technical assumptions made on the relationship between the environmental good and the surrogate market good (TEEB, 2010).

2.2.2.2. Stated preference valuation method

Stated preference methods use specially constructed questionnaires to elicit estimates of the WTP for or WTA a particular outcome. WTP is the maximum amount of money an individual

is willing to give up receiving a good. WTA is the minimum amount of money they would need to be compensated for foregoing a good.

Stated preference approaches simulate a market and demand for ecosystem services by means of surveys on hypothetical (policy-induced) changes in the provision of ecosystem services. Stated preference methods can be used to estimate both use and non-use values of ecosystems and/or when no surrogate market exists from which the value of ecosystems can be deduced (TEEB, 2010).

Stated preference (SP) methods seek to measure individuals' preferences for environmental quality directly, by asking them to state their preferences for the environment. It includes contingent valuation and choice experiment model (Dawit, 2014).

Contingent Valuation Method (CV): Uses interview schedule to ask people how much they would be willing to pay to increase or enhance the provision of an ecosystem service, or alternatively, how much they would be willing to accept for its loss or degradation (TEEB, 2010).

Choice Experimental Method (CM): Attempts to model the decision process of an individual in a given context (Hanley and Wright, 1998; Philip and MacMillan, 2005). Individuals are faced with two or more alternatives with shared attributes of the services to be valued, but with different levels of attribute (one of the attributes being the money people would have to pay for the service) (Ibid).

Generally stated preference techniques are often the way to estimate non-use values. Concerning the understanding of the *objective of choice*, it is often asserted that the interview process, assures "understanding of the object of choice, but the hypothetical nature of the market has raised numerous questions regarding the validity of the estimates (Kontoleon and Pascual, 2007). The major question is whether respondents" hypothetical answers correspond to their behaviour if they were faced with costs in real life (*Ibid*).

2.3. Empirical Literature Review

Noss and Cooperrider (1994) proposed four sets of values for conserving biodiversity: direct utilitarian values, indirect utilitarian values, recreational and aesthetic values and intrinsic, spiritual, and ethical values. Direct utilitarian values consider all species as objects for the use for direct benefit to humans. Indirect utilitarian values derive benefits from ecosystem services, such as climate stabilization, flood control, and the maintenance of air and water

quality. Recreational and aesthetic values have generally been implicit in maintaining places such as national parks, refuges, and natural reserves, for their beauty and outdoor recreational uses. Finally, intrinsic values indicate that all species deserve an equal opportunity to persist and, as humans, we have a moral and ethical responsibility to conserve all living things. Direct utilitarian values are criticized for potential danger to the species that appear to have no tangible benefits to humans. Meanwhile, intrinsic values are also criticized for their failure to lessen current rates of species extinction for Post-Industrial Revolution Society as a whole (Jin-Oh, 2008).

Vira and Kontoleon (2010) examined the evidence on the extent to which the poor depend upon biodiversity for their livelihood and/or household economy. According to the result of the study result in table 2, majority of the poor are dependence on the contribution of biodiversity to sustain their livelihood. Table 2 shows that the extent of different regions and the type of resources on which people depend on for income.

Table 2: Evidence on dependence on biodiversity for income

Source	**Region**	**Evidence**	**Resource type**
Bahuguna, 2000	South Asia	48.7% of household income	Forests: fuel, fodder, Employment
Bene *et al*., 2009	West Africa	Varies from 90% (poorest) – 29.7% (richest)	Fish
Cavendish, 2000	Southern Africa	35.4% of household income in 1993-94; 36.9% in 1996-97	Wild foods, wood, grasses and other environmental Resources
Fisher, 2004		30% of household income	Forests
Kamanga *et al*., 2009		15% of total household income	Forests
de Merode *et al*., 2004	West Africa	24% of cash sales	Wild foods
Fu *et al*., 2009	Other Asia	1.7% of household income in Site 1, 12.2% in Site 2	NTFPs
Jodha, 1992	South Asia	14-23% of total household income	Common pool resources
Levang *et al*., 2005	South-east Asia	30% of total household income	Forests
Mamo *et al*., 2007	East Africa	39% of total household income	Forests
Narain *et al*., 2008a	South Asia	Q1: 9%, Q2: 7.2%; Q3: 7.9%; Q4: 8% of permanent income	Fuel wood, dung for construction wood fuel, manure, fodder,
Viet Quang and Anh, 2006	South-east Asia	For 30% of households, over 50% of total income; and for 15% of HHs, 25-50% of total income	NTFP

Source: Adapted from Vira and Kontoleon (2010).

Overall, this data suggests reasonably high levels of dependence on biodiversity in terms of its contributions to household incomes. In addition to this, levels of participation in biodiversity based livelihood activities are also high, suggesting that the depth of dependence on these resources is very high.

In addition to this, the contribution of biodiversity for livelihood and/or economy also studied by different researchers and academicians. According to global business article, at least 40% of the world's economy and 80% of the needs of the poor are derived from biological resources. In addition the richer the diversity of life, the greater the opportunities for medical discoveries, economic development, and adaptive responses to such new challenges as climate change (Global Business, 2016). The World Bank (2001) highlighted that; more than 1 billion people depend on forests for their livelihoods to varying degrees. The assessment also revealed that sixty million indigenous people are almost wholly dependent on forests, while around 350 million people living within or adjacent to dense forests depend on them to a high degree for subsistence and income. In developing countries, agro-forestry farming schemes support 1.2 billion people and help sustain agricultural productivity and the generation of income. Forest industries provide employment for some 60 million people worldwide. The medical needs of approximately one billion people depend on drugs derived from forest plants, many of which have been long been used in traditional medicine (EFTEE *et al*., 2005).

This study carried out a meta-analysis of the results reported by 54 studies that investigate the extent to which rural households in developing countries (particularly African countries with an even mix of studies focussing on wet, semi wet and dry forests) depend on income from forest resources. In the analysis undertaken, the average household derived approximately US$678 per year (adjusted for purchasing power parity) in terms of forest income. Overall, total average household income was US$3043, implying that forest income is around 22% of total income. Vedeld *et al*., (2004) also note that although agriculture and off-farm income generally display higher income shares, forest uses represent a significant source of income, being particularly important for households close to the survival line. Forest income is shown to be of particular significance with respect to 'gap filling' and 'safety nets', providing an additional source of income in periods of both predicted and unpredicted shortfalls in other livelihood sources (Ibid).

Some of the contribution of biodiversity is ecosystem services such as water, agriculture, hydraulic power etc. Agriculture is a critical economic sector, especially in the developing world. It is most important to the economies of low-income countries, accounting for

approximately 31% of GDP overall and 50% of GDP in Sub- Saharan Africa. In the middle and high income countries, by contrast, it accounts for 12% and 1-3% of GDP, respectively. Yet conventional measures of GDP greatly understate agriculture's contribution to the economy, which should also include upstream and downstream manufacturing and services. Agriculture also provides many jobs, in the order of 56% to 65% of the total labour force in Asia and Sub-Saharan Africa (EFTEE, 2005).

In Africa biodiversity plays an important role in supporting GDP of the national economy. According to Tanzania National Report (2014), biodiversity is critical to the national economy contributing more than three quarters of the national GDP and sustaining livelihoods of majority of Tanzanians. Agriculture, livestock, forestry, and fisheries together contribute over 65% of GDP and account for over 80% of total employment and over 60% of the total export earnings. Furthermore, forests provides for over 90% of energy consumption in the country while hydropower contributes about 37% of power supply in the country. The average Total Economic Value (TEV) of catchment forest reserves was established to be more than 17,250 USD/ha. On the other hand, tourism industry is now worth over US$1 billion annually.

In Ethiopia, the study analyses the economic value of Ethiopian wildlife Conservation Authority (EWCA) managed protected areas, based on two case studies as well as on a national PA system's level. Protected areas provide direct benefits from tourism and job creation. In 2008/09 EWCA realised about US$ 19,000 from entrance fees to national parks. Apart from direct benefits from tourism, employment and entrance fees, the main value of protected areas is found in the environmental services they provide. They are an integral part of the sustainable development of the Ethiopian economy and form the basis for the various benefits and their respective values. A number of environmental services have been valued, such as hydrological services (valued at US$432 million), electric power generation (valued at US$28 million), medicinal plants (valued at US$13 million), carbon sequestration (valued at US$938 million or US$19 million per annum) and the value of biodiversity (estimated to be US$ 3.75 to 112 million per annum) (OBF, 2009).

Considering the high levels of endemism as well as the unique nature of landscapes and vegetation classes it is assumed that the overall value of biodiversity in Ethiopia could be in the higher end of the valuation range provided (OBF, 2009). According to OBF protected area value assessment study result (2009), the value of Simien Mountain National Park in general was estimated as follows:

Table 3: Different Values of SMNP

S.No	Description of Value	Low scale	Upper Scale	Total [million US$]	Remark
1	Hydrological Value	5	154	5 to 154	
2	Carbon Stock	Size (Ha)	Carbon Stock (tCO2)	Carbon Value (US$)	Annual Loss (US$)
		33,344	993,381	3,973,523	79,475
3	Biodiversity	Area/Ha		Biodiversity US$/annum [million US$]	
		41,200		0.04 - 1.24	
4	Value of Medicinal Plants	41,200		US$3.52/ha [US$] 145,024	

Sources: Reviewed from OBF Assessment Report, 2009

3. RESEARCH METHODOLOGY

In this chapter research methodology which has been used in this research has been discussed in detail.

3.1 Description of the study area

Simien Mountain National Park (SMNP) is one of the most well-known nature based recreational sites due to it's an impressive landscape and endemic wild animals. It was established in 1969 and was inscribed in the list of World Heritage sites by UNESCO in 1978. But this park has been in the list of world Heritage endangered since 1996 due to heavy settlement by farmers. This results in declining numbers of Walia ibex, widespread deforestation, and continuous reduction in recreational qualities of the site (Ali, 2011).

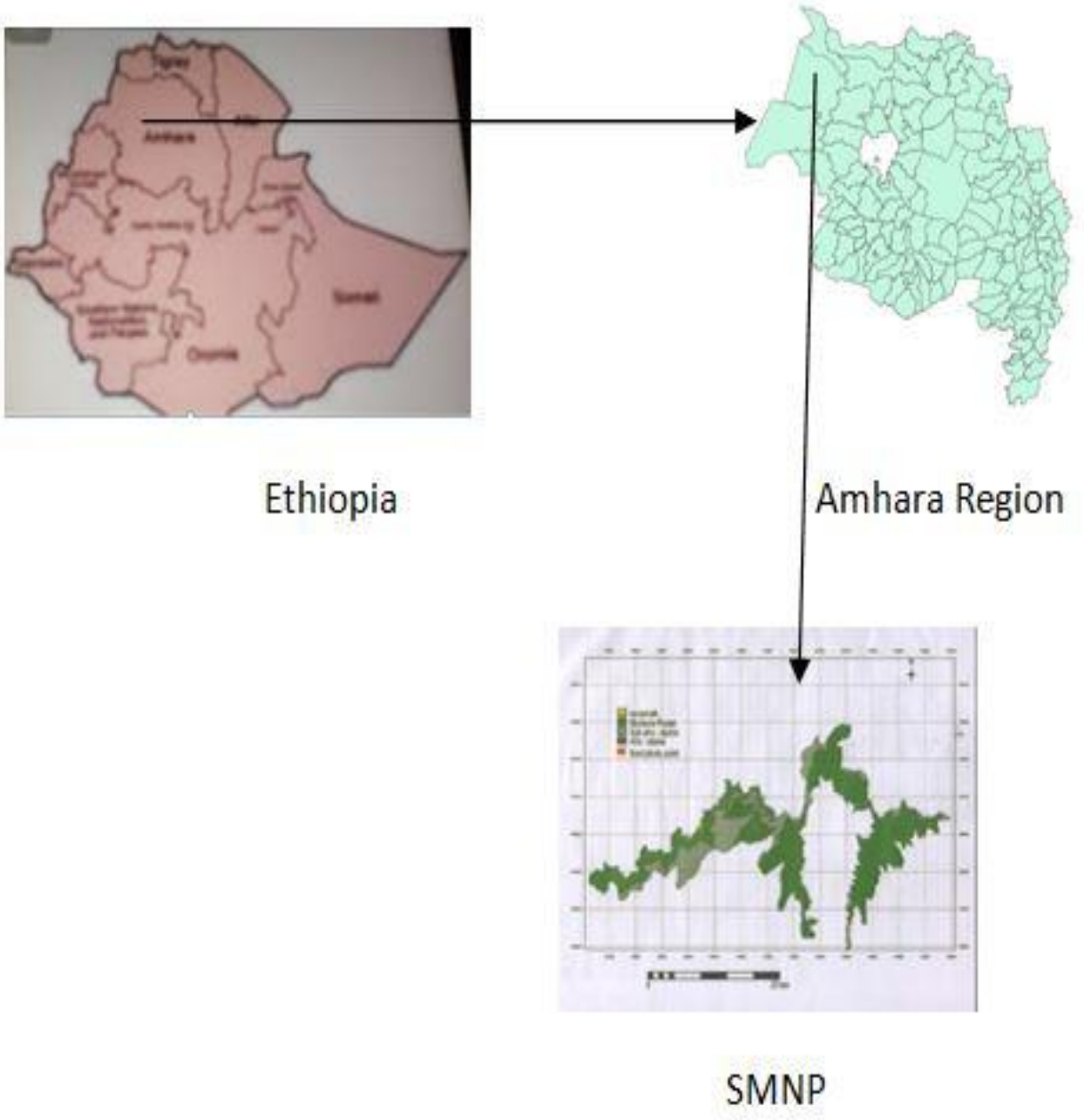
The SMNP, located in the zone of North Gondar of the Amhara National Regional State (ANRS) lies within five Districts: Debark, Adiarkay, Janamora, Beyeda and Teselmit, and borders 38 kebeles (after the new re-demarcation).

The Park is situated in the northern Ethiopia highland massif (about 846 km away from Addis Ababa and about 102 km from Gondar) where the highest peak in the country is found rising to 4543 meter above sea level (masl) with a breathtaking scenic beauty.

It was formally established in 1966 and at the time of gazetting under the Negarit Gazetta No 4 of 31st October 1969, Order No 59 of 1969 the Park boundary encompassed an area of 136 km^2. Re-demarcation of the Park boundaries was carried out in 2003 and 2007 to exclude villages situated on the edge of the Park and some areas under cultivation based on the recommendations of the World Heritage Committee as part of the process towards removal of SMNP from the World Heritage endanger list.

The current Park extends from 37^{0}51'26.36"E to 38^{0}29'27.59''E longitude and from 13^{0}06'44.09 " N to 13^{0}23'07.85" N latitude. The total area of the park including the recent extensions is about 412 km^2 and it has been re-gazetted by Negarit Gazetta as Simien Mountains National Park Designation Councils of Ministers Regulation No. 337/2014, 2015.

Figure 4: Simien Mountains National Park New Map



Source: Adopted from Simien Mountains National Park New Map, (2015)

The study covered three ecological zones of SMNP and its buffer zone (Low, mid and high land areas of the park): Low land areas (Debark Districts), mid-hills (Beyeda, Janamora and Debark Districts) and high mountains (Ras Dejen Beyeda District).

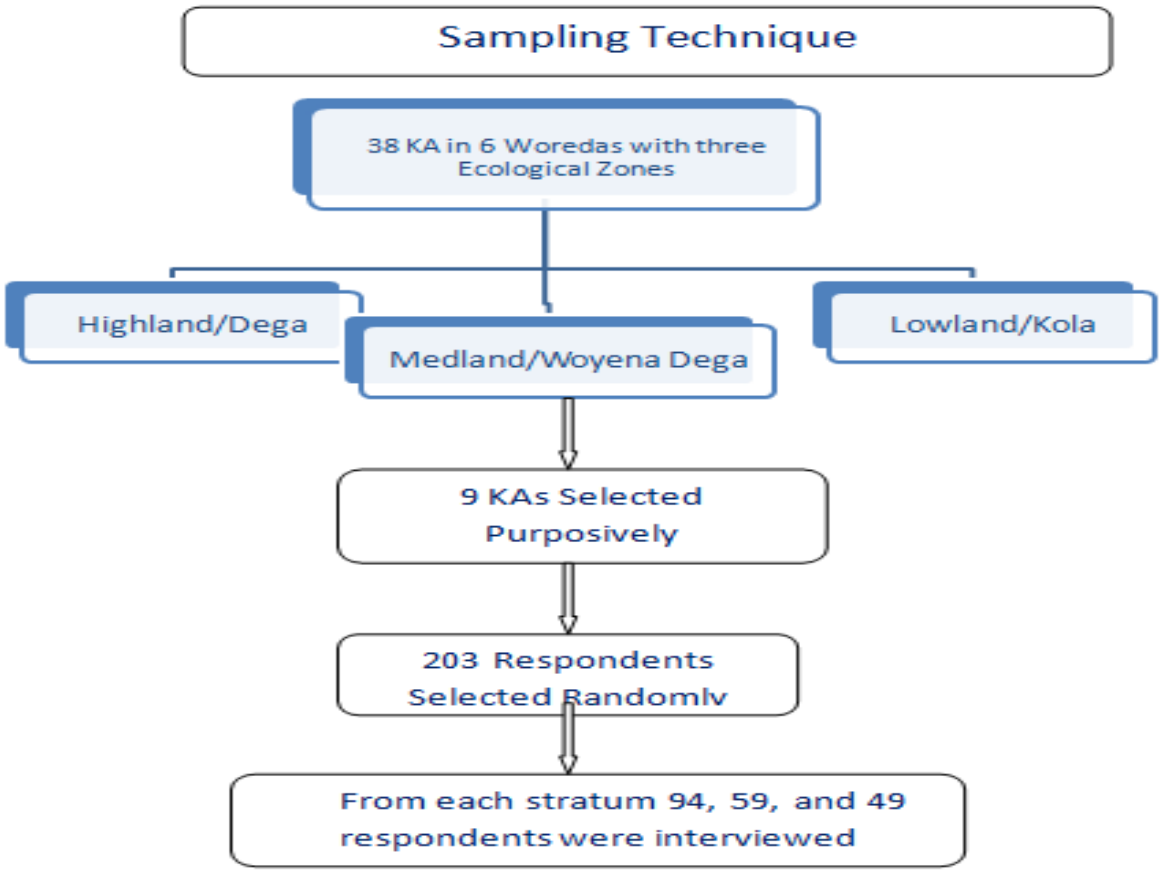
3.2 Sampling Methods

To address the objective of the research data were collected from selected respondents using the above mentioned data collection methods. The sampling technique and the sample size determining procedure are detailed below.

3.2.1 Sampling Technique

For this study 203 respondents who were represented from nine KAs out of 38 KAs of SMNP ecosystems had been contacted and interviewed.

Figure 5 Sampling Procedure



The number of interviewed respondents from each KA was determined based on the statistical formula. Each respondent was randomly selected from tax payers' registration book, thus, people who are not tax payer were not considered as a respondent for this study.

Table 4: Proportional representation of HHs for interview in each target KAs of the study area

S.no	Name of KA's	Name of Districts	Ecological Zone	Total HHs in the KA [N]	Sample HHs taken [n]	Remark n = 203[N_1/9508]
1.	Atigeba	Janamora	High Lnad	1186	25	n_1= 203[1186/9508]
2.	Bahir Amba	Janamora	High Land	825	18	n_2= 203[825/9508]
3.	Debir/Mikara	Debark Zuria	Midland	860	18	Approximate value
4.	Zebena	Debark	Midland	484	10	
5.	Dib-Bahir	Debark	Lowland	820	18	
6.	Adi/Miligebsa	Debark	Midland	1464	31	
7.	Ade/tsion	Debark	Lowland	1463	31	
8.	Bashaye	Beyeda	Highland	1031	22	
9.	Janbelew	Beyeda	Highland	1375	29	
Total				9508	203	

Source: Computed from survey data, 2017

From the above KAs Ade/tsion and Dib-Bahir represents low land, Debir/Mikara, Zebena and Adi/Miligebsa represents mid-land and the reset represent high land from each district. These KAs have been selected based on ecological stratification criteria purposively.

In choice experimental model, possible sampling strategies includes a simple random sample, a stratified sample, and a choice based sample can be used (Getenet, 2012). For this study stratified sampling was employed to identify the source population, the study population and sample population. Because stratified sampling ensures that at least one observation is picked from each of the strata, even if probability of it being selected is close to 0.

For this study source/target population was a person living in four districts (namely, Debark, Debark Zuria, Janamora and Beyeda districts) out of six Districts which surrounds the national park. The study population was people living in and around SMNP in 38 KAs which surrounding/bordering SMNP. The total estimated population who are living in and around SMNP is 202,827/100434F (40565 [2]HHs) (SMNP, 2014/15), this is a sample frame for this research from this total study population only 9508 people from 9 KAs were considered as sample frame and only 203 HHs were randomly selected as sample respondent and/or

[2] According to Simien Mountains National Park Office survey 2014/15, the total population of SMNP surrounding Woredas estimated 202,827/100434F and 40,565 HHs.

population for this study. Thus, from each stratum, highland, temperate and lowland ecological zones, 94, 59, and 49 respondents were interviewed, respectively.

3.2.2 Determining Sampling Size

Sampling size was determined using Solvin's formula (1960) which is as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where: N: is the population size
n: is the sample size
e: is the margin of error
1: the constant value

Using the above formula 203 respondents[3] was selected randomly as sample respondents from 9 Kebele Administrations (KAs) out of 38 KAs which boarding and/or surrounding SMNP. For this study, respondents were contacted from three ecological zone such as highland/Dega, Temperate zone/Woyina Dega and Lowland/Kolla) and from each stratum respondents were selected using simple random sampling technique. These contacted respondents were registered tax payers in respective KAs.

3.3 Data Collection Methods

For this study both qualitative and quantitative primary data were collected. The data for this study were obtained from primary sources. It was gathered from randomly selected sample respondents who live in and around SMNP using semi-structured interview schedule. The highest priority and care was given to the data sets to include all the information necessary to represent all the variables to estimate the intended models.

Face-to-face (in-person) interview data collection method was employed to gather the required data from primary sources. The interview was administered using five enumerators who holds a minimum of BA/BSc degree and who know the local language and norms of the community. Enumerators were oriented and trained on the semi structured interview schedule,

[3] For this calculation it has been used estimated household population in target KAs which is 38,176 HHs and the error term is around 7%.

how to present the respondents with the problem/questions, how to approach each respondents, and on other ethical issues.

Before the actual data collections, the semi-structured interview schedule was tested and some adjustments were made. Though enumerators were employed to collect the data, each and every data collection process was supervised at all time.

3.4 Data Analysis Method

The collected data were encoded before entered into LIMDEP8.0/NLOGIT3.0 econometric software for analysis. Then collected data were entered into the econometrics software in order to estimate both the multinomial and random parameter logit models. Choice experimental method was employed for result estimation of the four biodiversity attributes with five choice sets each and a total of 1015 observation. To estimate the economic value of biodiversity, multinomial logit models (Basic and extended MNL) and random parameter logit model (RPL) were used.

3.5 Choice Experiment Method

The Choice Experiment (CE) method has its theoretical grounding in Lancaster's model of consumer choice (Lancaster, 1966), and its econometric basis is Random Utility Model (RUT). Lancaster proposed that consumers derive satisfaction not from the goods themselves but from the attributes they provide (Dawit, 2014).

Choice modelling (often referred to as choice experiments) is a stated preference valuation technique. The choice modelling (CM) technique estimates economic values by constructing a hypothetical market for the non-market environmental good, e.g. biodiversity. However, rather than being given a discrete Yes / No choice (as in contingent valuation), respondents were presented with a series of choice tasks in which they are asked to choose their preferred policy option from a list of (usually) three options; one of which normal includes maintaining the status quo or a "do nothing" option. Each option is described in terms of a bundle of attributes describing the good (including a price attribute) presented at various levels according to an orthogonal fractional factorial experimental design. The analysis of respondent choices is based on random utility maximising (RUM) theory (DEFRA, 2008).

In choice modelling, individuals are faced with two or more alternatives with shared attributes of the services to be valued, but with different levels of attribute (one of the attributes being the money people would have to pay for the service). In a CM study, respondents within the

survey are given a choice between several options, each consisting of various attributes, one of which is either a price or subsidy. Respondents are then asked to consider all the options by balancing (trading off) the various attributes. Either of these techniques can be used to assess the TEV from a change in the quantity of biodiversity or ecosystem services. Though the CV method is less complicated to design and implement, the CM approach is more capable of providing value estimates for changes in specific characteristics (or attributes) of an environmental resource (TEEB, 2010).

For this study choice experiment method is employed, among other *stated preference* environmental valuation methods like contingent valuation method (CVM)[4], to address research objectives due to a number of reasons, the most important being:

- The choice experiment method allows for estimation not only of the value of the environmental good as a whole, but also of the implicit values of its attributes;
- The strategic bias, that is stating an extremely high/low value to get a point across, is minimised in choice experiment method since the prices of the goods are already defined in the choice sets;
- Willingness to accept (WTA) questions can be asked in choice experiments without the risk of facing huge discrepancies between willingness to accept (WTA) and willingness to pay (WTP) values as they are reasonable and predetermined. It has been found that in CVM studies individuals seem to attach much more value to losses than they do to gains hence WTA values exceed WTP values considerably (Sinafikish, 2008).

In addition, only the choice model did not rely on existing data, but was also the most time consuming and expensive method to implement (DEFRA, 2008).

3.6. Design of a Choice Experiment

In this section attributes and their level have been defined, designs of the experiment and interview schedule have been discussed.

[4] CVM is the most commonly employed environmental valuation method where it involves asking respondents about their willingness to pay (WTP) or willingness to accept (WTA) to a proposed change in the level of provision of an environmental good (Sinafkish, 2008).

3.6.1 Definition of Attributes and Levels

In this research attribute is defined as a characteristic of biodiversity and their level is measurement of values assigned to each attribute.

The attributes of the interventions and their assigned levels are usually combined using experimental designs to produce a set of hypothetical choice alternatives. Respondents are then presented with a sequence of two or more of these competing choice alternatives and are asked to choose which alternative they prefer. The attribute-levels determine the utility respondents attached to a particular characteristic of an intervention, and hence, their choices or preferences, (Gilbert *et al*., 2014).

For this research attributes were identified from different literatures and the attribute level were assigned to each attributes based on the reality mean that current situation and the average annual tax payment level of the local community.

Table 5: Description of biodiversity attributes and levels to be used in Choice experiment method

Attributes	Description of attributes	Level of attributes
Fauna and Flora	The numbers and status of fauna and flora species as well as their habitats in and around SMNP.	**A) Low (status quo)**: the current number and status of both fauna and flora species and their habitats in and around SMNP are very scarce and many species of the ecosystem are degraded and people are affected due to this high degradation in many ways. **B**) **Medium**: the improvement and management of fauna and flora species and their habitat at a medium level (improving by 30 %.) **C) High:** the improvement and management of fauna and flora

		species and their habitat at a high level (improving by 50%).
Ecosystem services	The amount of environmental resources and number of ecosystem services obtained from the area are some of the benefit of biodiversity of the study area. The amount and use of biodiversity in the study are determined by availability and accessibility of ecosystem services for local community domestic use (for human and livestock water, grazing, agricultural production and productivity, climate regulation etc), direct use, sources of income from sale, accessibility of resources for local community, water sources for downstream users and hydraulic electric etc. It is measured in terms of the number of seasons with water, direct use of forest, climate regulatory services etc.	**A) Status quo**: All ecosystem services are highly limited because of degradation and their availability and accessibility is scarce. **B)** Only ecosystem services that have a direct impact on humans, e.g. flood defence, are restored **C**) All ecosystem services should be restored
Tourism facilities and infrastructural development	SMNP ecosystem has been one of the potential destinations for both local and foreign tourists. In and around SMNP, tourism has been used as one of the important income sources and one of the major livelihood options for the local community. Therefore the development and improvement of tourism services are key to increase number and satisfaction of tourists which has direct linkage with the income generated from the sector.	**A**) **Status quo**: There are no or limited facilities such as road, clean water, electricity etc. **B**) Infrastructural development such as road, electricity, clean water, provision of resting facilities such as of hotels and lodges and provision of general services like information provision etc should be improved.

	In addition to this, the development of recreational quality of the site such as infrastructure, hotels (lodges), resting facilities, information facilities etc are crucial in order to attract tourists. The local community can obtain benefits from these improvements directly or indirectly including creation of new job opportunities, direct income generation in case of different fees.	**C**) Infrastructural development, facilities improvement, services quality improvement and improved general services provision.
Monetary payment	Annual payment for the enhancement and management of ecosystem in and around SMNP. (as annual tax or new introduction of fee for conservation)	**A**) **Status quo:** birr 0, no payment **B)** birr 75 **C)** birr 100

Sources: Customized from information obtained expert consultation, 2016.

3.6.2 Experimental Design

In this research there can be 192 choice alternatives ($4^3X3^{1=}$ 192) in full factorial design. Thus, to reduce over burden of both the respondents and high cost of the research, in this study, orthogonalisation procedure was used to recover only the main effects, by having excluded identical and illogical choice sets.

It is important to find a good balance between offering too few and too many choice sets to one participant. Having too few choice sets, involves the risk of not having enough observations to investigate preferences thoroughly (Hensher *et al*., 2005).

Despite the statistical advantages of factorials, only the main effects are necessary because as the number of possible combinations becomes large and not tractable, one is motivated to reduce combinations into manageable number. So that it can able to undertake a practical work in the field without compromising preference variation, (Sinafikesh, 2008).

Table 6: Sample Choice Set

Which one from the following improvement plan do you prefer?

Attributes	Plan one	Plan two	Status quo
Fauna and Flora	High level improvement of fauna and flora (by 50 %.)	Medium level improvement of fauna and flora (by 30 %.)	No improvement measure
Ecosystem Services	All ecosystem services should be restored	Some ecosystem services that have a direct impact should be restored	No Change
Tourism and facilities	Infrastructural development facilities improvement, services quality should be improved	Infrastructural development and some facilities should be improved	No Change
Monetary Payment	birr 100	birr 75	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Sources: Designed based on information and consultation with experts, 2016.

3.6.3 Interview Schedule Development

For the purpose of first hand data collection from respondents, a semi-structured interview schedule was developed. In the questionnaire both the general questions and choice experimental questions were included. The interview schedule has four major parts. The first part was about the socioeconomic and demographic characteristics and status of the respondents. In this part, the respondents' sex, age, family size, number of dependents in the household, educational level, average annual income, number of livestock holding, and distance from the national park has been included. The first part includes questions about socioeconomic status of the respondents. These typically include the respondent's age, gender, household income, marital status, occupation, number of dependents, and educational attainment. The second part includes questions about the general perception and knowledge of the respondent about the SMNP ecosystem and biodiversity. Questions in this part were focused on the respondents' how-know regarding the importance of biodiversity, their observation about the status of biodiversity and major causes of biodiversity loss in their vicinity. This is followed by questions on general perceptions and observations of respondents about the SMNP and their relation from the national park. Specific questions about

respondents' relation with the national park, its importance and their concerns regarding the gazetting of the national park were covered. These questions focused on the socioeconomic vulnerability of the local community before and after the gazetting of the national park.

The next and the fourth part of the questionnaire consists questions regarding the choice experiment model. There are five choice sets with three plans/options each. Respondents were presented with the descriptions about the choice scenario before the choice experiment exercises. The scenario description was focused on four attributes including the monetary plan and their levels. In addition to this, it includes about the features and or current status of the national park and proposed improvement plans of the national park. Following the description, respondents were presented with the choice sets with five observations each. Choice experiment questions were followed by follow up questions designed to explore the motivations behind respondents' choices and understanding the reasons whether respondents were or were not willing to pay for the proposed hypothetical programs. These questions are important to identify protest responses that are responses of people that did not engage in the trade off exercises. Follow up questions are further aimed at explaining respondents views of the hypothetical programs they evaluated. These questions help for assessing the credibility and meaningfulness of the choice experiment exercises. A full description of the questionnaires and scenarios is annexed in the appendix (Please see Appendix 1).

3.7 Econometric Model Specification for Choice Experiment Model

Choice experiment (CE) is a technique that provides respondents with multiple choice sets, in which each choice set usually contains two or more management options. The options in each choice set contain common attributes, which can be at various levels. The respondents are asked to choose their most preferred option. This allows evaluating the impacts of different attributes on respondents' welfare (Ali, 2011).

There are numerous stated preference techniques for non-market valuation of environmental resources; however, choice experiment model is relatively more efficient than the above mentioned methods of valuation in valuing the multi- functional environmental resources such as wetland ecosystems. The reasons include choice experiment has the advantages of providing a richer data set, reduction of strategic bias, and benefit transfer potential, framing effect control and context flexibility (Bennett and Blamey, 2001). It consists of a family of survey-based methodologies for modelling preference for goods, where goods are expressed in terms of attributes they possess (Hanley *et a*l., 2001). In choice modelling respondents are

provided with various alternative descriptions of the good with different attributes and levels and asked to choose their best alternative (Ali, 2011). Therefore, in this study choice experiment modelling was applied for valuing the multiple goods and services provided by biodiversity.

The theoretical foundation of the discrete choice modelling is Lancaster (1966), who developed a characteristic approach for the analysis of demand. Since choice modelling elicits preferences from consumers, this method provides information about preference orderings within a set of choice options. The analysis of the data is based on random utility theory (RUM), originally proposed by Thurstone (1927).

Assuming the error terms of the resulting utility function are independently and identically distributed, a multinomial logit (MNL) model can be developed in order to derive the value of compensating surplus, (Morrison *et al.*, 1999). By using choice experiment, the indirect utility function of an individual i from alternative j is decomposed into the following observable and stochastic variables (Getenet, 2012):

$$U_{ij} = V(Z_j, S_i) + E \quad \ldots\ldots\ldots\

Furthermore the systematic component of the utility function can be expressed by using vector of explanatory variables and their coefficients as follows.

$$V_{in} = B' x_{in} \quad \ldots\ldots\ldots\

respondents' preference heterogeneity as independent variables in explaining the probability of choice (*Ibid*).

3.7.1 Random Parameter Logit Model (RPL)

Standard multinomial logit model has two main problems (Alpizar *et al*., 2001). First the model assumes no correlation among the unobserved disturbance terms i.e. it is based on the assumption of independence of irrelevant alternatives (IIA) which is not always realistic. This problem comes as a result of the IID assumptions of the model. The second problem of the MNL model specification is that it doesn't take into considerations the test variation of individuals. However, the random logit model provides a simple way to generalize the multinomial logit model-to permit the utilities of each alternative to be correlated (Alpizar *et al*., 2001).

By relaxing the assumptions of conditional logit model, the random utility function in the random parameter logit model will take the following form (Birol *et al*., 2005):

$$U_{in} \equiv V_{in} + \mathcal{E}_{in} \equiv Z_i(\beta + n_{in}) + \mathcal{E}_{in} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 6$$

Where respondents n receives utility U choosing alternative i from a choice set C. Utility is decomposed into a non- random component (V) and stochastic term (**ε**); and the indirect utility is assumed to be a function of the choice attributes Z with parameters β (and socio-economic characteristics, if they are included in the model) that may vary across respondents by a random component n_n due to preference heterogeneity. Thus, the probability of choosing alternative i in each of the choice sets will have the following form (Ibid).

$$P = \frac{e^{zin(\beta+\eta n)}}{\Sigma e^{zjn(\beta+\eta n)}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 7$$

As noted by Birol *et al*., 2005, since the random parameter logit model does not require the IIA assumption, the stochastic part of utility may be correlated among alternatives and across the sequence of choices via the common influence of ηn. Moreover, it is indicated that in terms of overall fit and welfare estimates, random parameter logit model is superior to conditional logit model and it is also used to account variations in tastes across populations. Thus the general form of the choice experiment in random parameter model is:

$$V_i = ASC + \Sigma \beta_k Z_k + \Sigma \beta_m S_m \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 8$$

Where ASC is alternative specific constant that captures effect of any attribute that are not included in the choice specific attributes or it captures the status quo bias. K is the number of attributes and m is the number of socio-economic characteristics of the respondent. Since

socio-economic factors are constant for any individual, it can only enter as interaction terms with the attributes or alternative specific constant.

3.7.2 Part Worth

Implicit prices for biodiversity attributes are the estimations of the WTP of respondents for an increase in the attribute of concern, given that everything else is held constant. Implicit prices are determined using the following formula:

$$(\boldsymbol{Implicit\ Price(Part\ Worth)}) = -\left(\frac{\boldsymbol{\beta}_{\text{non-market attribute of biodiversity}}}{\boldsymbol{\beta}_{\text{monetary attribute}}}\right) \ldots\ldots\ldots\ldots \mathbf{9}$$

Where, β are the estimated coefficients of the attributes in the multinomial or random parameter logit model. In addition to the estimation of values of individual attributes, the compensating surplus relating to a change in overall conditions can be also estimated by using the following formula:

$$\boldsymbol{Compensating\ Surplus} = -\left(\frac{\mathbf{1}}{\boldsymbol{\beta}_{\text{Monetary attribute}}}\right)(\boldsymbol{V}_0 - \boldsymbol{V}_{\text{i}}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \mathbf{10}$$

Where:

- V_0 is the value of the indirect utility associated with the status quo.
- V_i is the indirect utility associated with different alternative improvement scenarios or plans (improvement plans which is $plan_1$ and $plan_2$ please see attribute and level below) with their specific levels of the attributes.
- β is the estimated coefficient for monetary attribute.

3.7.3 Specific Equation for Choice Experiment

The collected data from respondents were entered into the LIMDEP8.0 NLOGIT3.0 econometrics software in order to estimate both the multinomial and random parameter logit models. In the multinomial logit model two different multinomial functions were estimated. The first model is the basic multinomial logit model which is the function of the attributes of biodiversity alone. The second model is called the extended multinomial logit model that includes the interactions of the socio-economic variables with the ASCs in addition to the biodiversity attributes. In both multinomial logit models, three indirect utility functions for the respective three alternatives were derived. These were utility function for status quo option,

$plan_1$ and $plan_2$. The specification for these utility functions and hence the basic multinomial logit model is the following.

Model 1: Basic MNL Model

In the basic MNL model the utility function is assumed be linear and has additive form. It is the functions of attributes of the alternatives and the alternative specific constant (ASC). The utility function of the basic model would take the following general form:

$$[Vi = ASC + \ \beta_1 1FF + \beta_2 ES + \beta_3 TF + \beta_4 PC] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 11$$

Where: ASC = 0 for status quo option and one for plan1 and plan2. In addition to this $\boldsymbol{\beta_1}$, $\boldsymbol{\beta_2}$, $\boldsymbol{\beta_3}$ and $\boldsymbol{\beta_4}$ are the coefficients associated with each of the four attributes, i.e. improvement in FF (fauna and flora), ES (availability and accessibility of ecosystem services), TF (tourism and facilities) and PC (monetary payment) for conservation, respectively. The three specific utility functions for those three alternative scenarios represented as:

$$[V1 = ASC_1 + \beta_1 1FF + \beta_2 ES + \beta_3 TF + \beta_4 PC]$$

$$[V2 = ASC_2 + \beta_1 1FF + \beta_2 ES + \beta_3 TF + \beta_4 PC]$$

$$[V0 = \beta_1 1FF + \beta_2 ES + \beta_3 TF + \beta_4 PC]$$

Where: V_1, V_2, V_0 were denoted as the utility for alternative one, two, and the status quo respectively. ASC_1 and ASC_2 are two alternative specific constants for $plan_1$ and $plan_2$. According to Bennett and Blamey (2001) the two ASCs for improvement plans are constrained to be equal, because of a generic format and an experimental design that was close to orthogonal were used to develop the choice sets and hence we included one common alternative specific intercept for the three alternatives that imply changes**.**

Model 2: Extended MNL Model

The above basic multinomial logit model is estimated based on the assumption of preference homogeneity i.e., it assumed that preferences are homogeneous across individual respondents. But this is not being always realistic. Rather preferences are heterogeneous across individuals and such heterogeneity need to be accounted through interacting socioeconomic variables with either attributes or ASCs and use them as independent variable in the utility equation so as to have unbiased estimates (Birol *et al*., 2005, Getenet, 2012). However, due to a possible multicollinearity problem, all possible interaction between the socio-economic characteristics

and attributes should not be included. Moreover, it has to be recognized that they cannot be introduced separately in the model.

Because respondent's characteristics do not vary across alternatives, "Hessian singularities" arise in the model unless the socio-economic characteristics are introduced as interactions with either the attributes or the ASCs (Bennett and Blamey, 2001). Eight socioeconomic variables sex, age, family size, number of dependents, education, income, number of livestock, and distance from the mountain were included in this extended model as interactions with the ASCs which enable to capture the influence of the variables on the probability of the respondent to choose either plan. The specification of this model is given as follows:

$$[V_i = ASC + \beta_1 1FF + \beta_2 ES + \beta_3 TF + \beta_4 PC + \lambda_1 ASC_i * \text{SEX} + \lambda_2 ASC_i * \text{AGE} + \lambda_3 ASC_i * \text{EDU} + \lambda_4 ASC_i * \text{FAMSIZ} + \lambda_5 ASC_i * \text{NUMDEPS} + \lambda_6 ASC_i * \text{INC} + \lambda_7 ASC_i * \text{NOLIVESTOCK} + \lambda_8 ASC_i * \text{DISKM}] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 12$$

3.7.4 Definition of Variables and Expected Signs in the Choice Experiment

ASC: This represents Alternative Specific Constant and takes values 1 for the attributes with changes ($plan_1$ and $plan_2$ in the choice sets, and 0 for the base (status quo) option (Sinafekish, 2008).

Fauna and Flora: This attribute refers to the numbers and status of fauna and flora species as well as their habitats in and around SMNP. Increasing the number of fauna and flora (especially endemic mammals like walia ibex and Ethiopian wolf, and indigenous trees such as Eyrica Arborea (Wuchena), and Hypercum Revoltum (Amuja)) and improving the status of their habitat improves the biodiversity status of the ecosystem and thus is assumed to increase the utility of the respondent and the expected sign of its coefficient will be positive.

Ecosystem services: This attribute refers to the amount of environmental resources and numbers of ecosystem services obtained from the ecosystem. The amount and use of biodiversity in the study area are determined by availability and accessibility of ecosystem services for local community domestic use. Thus, improving the status of ecosystem can increase amount and number of ecosystem services(such as water for human and domestic animals, non-timber forest products, grazing for domestic animals, etc) obtained from ecosystem which can satisfy the local community utility and its expected sign will be positive.

Tourism and facilities: This attribute considers tourism as one of the income sources of the local community. SMNP ecosystem has been one of the potential destinations for both local and foreign tourists. In and around SMNP, tourism has been used as one of the important income sources and one of the major livelihood options for the local community. Therefore, the development and improvement of tourism services are key to increase number and satisfaction of tourists which has direct linkage with the income generated from the sector. Thus, the development of recreational quality of the site such as infrastructure, hotels (lodges), resting facilities, information facilities etc can increase tourist satisfaction and then income from tourism which can contribute to biodiversity improvement in one way or another; thus, it expected sign will be positive (Getenet, 2012).

Monetary payment: This is annual payment by the community for the enhancement and management of ecosystem in and around SMNP (as annual tax or new introduction of fee for conservation). Thus, increasing annual payment can reduce utility of the respondents and the sign will be negative (Ali, 2011).

SEX: This variable represents the sex of the respondents. It is included in the study as a dummy variable, where 0 is for male and 1 for female, to test whether gender of respondents is an important determinant of choosing the improved plans on the biodiversity. This relationship is indeterminate as sex of the respondent (Ali, 2011).

AGE: This variable is respondents' age which is measured in years. Generally, a positive relationship is expected between person's age and the choice of improved environmental plans. This is because the person's interest in environmental improvement increases as s/he becomes older.

EDUC: This variable represents respondents' educational level in years of education. The more years of education that respondents have better understanding will have about biodiversity conservation, its importance and will have increased willingness to pay for conservation. Therefore, a positive relationship is expected between education and the choice of improved biodiversity plans.

FAMSIZE: This is family size measured as the total number of people in the respondents' household. A negative relationship is expected between FAMSIZE and the probabilities of choosing improved biodiversity conservation plan; this is because for a respondent with large family size spends a relatively more proportion of its income on the consumption. In addition, respondent with large family size will become less willing to pay for conservation; however, its dependence on biodiversity will be high.

NUMDEPS: The number of dependents (with no labour or money contribution and age below 13 and above 60) in the household will have negative influence on the biodiversity of the national park and its sign will be negative. The more the number of dependents in the household who has no contribution both labour and any income will depend on the natural resources especially on common properties.

INCOME: This is disposable annual income of the respondents. Since income reflects the ability to pay, a positive relationship is expected. This is due to the fact that those people with higher income can able to pay more and will satisfy much more by biodiversity conservation, as rich benefits more than poor from biodiversity.

NOLIVESTOCK: the number of livestock holding by the household especially if the production technology in not modern and intensive, the probability of influencing the biodiversity of the national park through free grazing might increase. The more the respondents have livestock, the probability of using communal lands and free grazing areas increase. Thus, this variable will have negative sign.

DISKM: This variable represents the distance from the national park that the respondent lives. That who lives far from the national park has minimal or no negative impact on the national park and vase versa. Therefore, this variable will have negative sign as there will be a possibility of the household to affect the national park in one way or another as the distance is near to the national park (Getenet, 2012).

4. RESULTS AND DISCUSSION

In this chapter descriptive and econometric results are discussed and results have been interpreted based on the findings of the study.

4.1 Descriptive Statistics

In this section findings of the research are presented and discussed in detail. Socio-economic characteristics, perception of respondents on biodiversity, status of biodiversity, major causes of biodiversity loss, local communities' livelihood strategies and mitigation/coping mechanisms have been discussed.

4.1.1 Demographic and Socio-economic results

The result of the descriptive statistics of the study shows that from the total of 203 interviewed households 61.6% and 38.4% were male and female, respectively. The mean age is 40 years and 84% of the interviewed were married, the rest were single/unmarried, divorced and widow, 9.9%, 3.9% and 2%, respectively.

Regarding the educational status of the respondents, the result of the study revealed that, 31.5% are illiterate who are unable to read and write and 13.3% respondents able to read and write but they didn't attend formal education, they might attend informal adult education such as alternative basic education and religious educations. According to the result, 5.5% of the respondents have certificate and above. According to the table below, those who have certificate and above educational qualification were found as government employees in the Kebele Administration (KA). In this study 12% of the respondents have attended education up to some level and they are engaged on mixed farming for their subsistence.

According to the study result, the mean family size is 5 and the mean average number of dependents in the household is 2 with the minimum and maximum of 1 and 5 dependents in each household, respectively. For this study respondents were rural farming community which accounts 92%. Thus, the mean annual disposable income of the household is 17645.49 birr per year. Respondents generate their annual disposable income from mixed farming. The mean land holding size of the respondent is 2.1ha per households; however, 50.7% of the respondents have 0-0.5 ha of land. The mean distance from the national park where respondents live is 3.38 km with the range of 1 to 7 km.

Table 7: Summary of Descriptive Statistics

Variable	Mean	Std. Dev.
Age	40.02	9.40
Family Size	5.32	1.54
Number of Dependents	2.41	1.06
Education	2.59	3.14
Income	17545.64	11737.44
Number of Livestock/TLU	1.64	1.78
Land Size	2.10	1.44
Distance in KM	3.38	1.94

Source: Computed from survey data, 2017

4.1.2. Perception of Respondents about Biodiversity Status of the ecosystem

Knowing the perception and level of respondents' knowledge about biodiversity will help to design appropriate improvement plan in the study area. Thus, in this research it was highly interested to know the perception and knowledge of the local community about biodiversity and its importance. Surprisingly almost all respondents responded that they know about biodiversity and its importance given the level of understanding and knowledge of the respondents. The result shows that 90% of the respondents have some sort knowledge and information about biodiversity and its importance.

According to respondents' response biodiversity is importance as a source of ecosystem services and it helps to regulate adverse climate change effects 17.0% and 15.4%, respectively. The result below revealed that respondents believe biodiversity is important as a sources of income and household energy, livelihood improvement, improve agricultural production, and enhance tourism in addition to other importance 6.9%, 8%, 10% and 11.8%, respectively.

Respondents were also asked the sources of information and where they get the information about the importance of biodiversity. The result of this study revealed that 31% of the respondent obtains the information from KA development agents and 22% of the respondent trained about biodiversity by different NGOs and other organizations with similar thematic focus. According to the response 19% of respondents obtained some sort of information and experience about biodiversity from trained colleagues in their vicinity.

Based on the respondents level of understanding and perception they were asked to compare the status of biodiversity in the ecosystem before and after ten years from now. According to the result of the study 89% of the respondent believed and perceived that there is high biodiversity degradation and the intensity of degradation is increased from time to time. Table 8 revealed that only 3.9% of the respondent said there is improvement of biodiversity status in their vicinity. These respondents who believed the biodiversity status is improving are those who live in the lowland area of Debark district particularly in Dib-Bahir Kebele. According to information obtained from respondents, forest cover in the KA improved because of high environmental protection and the area has been included as SMNP during re-demarcation and park expansion. However, the personal observation confirms that there is high degradation of biodiversity in and around SMNP.

Table 8: Information on status of biodiversity in the study area

Biodiversity status	N	Response %
Improved	8	3.9
Degraded	181	89.2
As it is/no change	9	4.4
I don't know	5	2.5
Total	203	100.0

Source: Computed from survey data, 2017

4.1.3. Major Causes of Biodiversity Degradation

Respondents were able to identify and list out the associated major causes of biodiversity loss in the area. According to the result of the study, respondents recognize that Agricultural encroachment because of high population increment, deforestation because of human induced problem, and overgrazing were listed out as major causes of degradation.

The result revealed that agricultural encroachment is one of major cause of biodiversity loss which 95.6% of the respondents strongly agreed on it followed by deforestation and overgrazing which respondents strongly agreed 84.2% and 50.2%, respectively.

Table 9: Cause of Biodiversity Degradation

Degree	Agricultural Encroachment Response %	Deforestation Response %	Overgrazing Response %
Strongly Agree (4)	95.6	84.2	50.2
Moderately Agree (3)	3.9	13.8	45.8
Agree (2)	.5	1.5	3.0
Neither (1)	0.0	0.0	.5
Disagree (0)	0.0	0.0	.5
Total	100.0	100.00	100.0

Sources: Computed from survey data, 2017

According to the survey result, respondents mentioned that the effects of biodiversity loss are reduced agricultural production and productivity (34.5%), adverse climate change effect (26.7%) and limited ecosystem services (24.5) (Table 10).

Table 10: Negative effects of biodiversity loss

Effects of biodiversity loss	**N**	**Response %**
Reduced production and productivity in Agriculture	70	34.5
Adverse climate change effect	54	26.7
Loss and/or reduction of ecosystem services and aesthetic values of biodiversity	50	24.5
Increased cost of conservation, input purchase etc	29	14.3
Total	**203**	**100.0**

Source: Computed from survey data, 2017

In addition to the reduction of production in the agriculture sector, the local community also obliged to increase cost of production factors such as chemical fertilizer and forced to spend their time and labour for conservation and rehabilitation works. In connection with biodiversity degradation the local community also said that income from biodiversity highly reduced from time to time. According to the survey result 79.8% of the respondents explained that annual income from agriculture reduced and productivity of land significantly affected because of biodiversity degradation.

However, given high degradation of biodiversity in the study area, still biodiversity is considered as one of the income sources for local community. The local community was

asked to tell the percentage of income particularly obtained from biodiversity. The estimated percentage is shown in the following table (Table 11).

Table 11: Percentage of income from Biodiversity

Percentage of income generated from natural resources	N	%
1-3%	82	40.4
3.1-5%	43	21.2
5.1-7%	24	11.8
7.1-10%	23	11.3
>10%	31	15.3
Total	203	100.0

Source: Computed from survey data, 2017

According to the result, 40.4% of the respondent believes 1-3% of their annual income is generated from biodiversity and 15.3% of the respondents mentioned that above 10% of their annual income is from biodiversity.

4.1.4. Mitigation strategy of biodiversity loss

As mentioned in the previous section respondents were suffering from negative effects of biodiversity loss. According to the result of the study, 78% of respondents mentioned that agricultural production and productivity reduced because of biodiversity loss. As a result of this biodiversity loss respondent dependent on other means of income and livelihood options. Some of the mitigation strategies that the respondent uses as a means of mitigation from biodiversity loss and its effect detailed in the following table below.

Table 12: Mitigation strategy

Mitigation Strategy	Response (%)
Changing livelihood options from agriculture to other means of alternative income sources	24.8
Use natural resources as means of income and food	3.4
Rent out own farm land to others	16.7
Work for others as a daily labourer	26.5
Migrate to other places in search of work	17.8
Depend on PSNP support and other aids	10.7
Total	**100.0**

Source: Computed from survey data, 2017

According to the result of the above table the respondent uses the mentioned mitigation strategies during slack time in particular and to mitigate community problems such as food insecurity, loss of livelihoods etc which can be aggravated due to biodiversity loss in the study area.

In this study 24.8% of the respondents shift from agriculture to other means of livelihood such as petty trading, tourism services etc to generate income for their household and those who have farm land used to rent their farm land for others which accounts about 16% of the respondents. About 26.5, 10.7, and 17.8 % of the respondents were also used daily laborer, PSNP support and other aids and migration to other areas as mitigation strategies, respectively.

In addition to the above mitigation methods the local community have other livelihood diversification strategies to sustain their families' income and livelihood options. The table below shows the livelihood diversification strategies of the local community in and around the national park.

Based on the result of this study, 40% of the respondents mentioned that they use off-farm Income Generating Activities (IGA) as one of the most important livelihood diversification strategy and followed by tourism service which accounts about 21% of the respondent response. The local community also uses petty trade (18.2%) and service sector employment (6.3%) as a means of livelihood improvement strategies in the study area.

Table 13: Livelihood Diversification Strategies

Livelihood Strategies	N	**Responses (%)**
Petty Trading and small scale business	37	18.2
Tourism services and	43	21.2
Employment service sector at the nearby urban areas	13	6.4
Engage on off-farm IGA such Fattening, beekeeping, etc	81	39.9
Other such as seasonal employment at lowland areas of the country as daily labourer	29	14.3
Total	**203**	**100.0**

Source: Computed from survey data, 2017

4.1.5. Vulnerability of the local community before and after SMNP establishment

In addition to economic value of biodiversity in the study area one of the interests and specific objective of this study was to know the local communities' socio-economic vulnerability in relation to the establishment of the national park. To know exactly how much the local community negatively or positively affected on qualitative base, the local community was asked to tell the researcher about how much they impacted because of the establishment of the national park, as the establishment of the national park my affect the local community in one way or another.

To do so respondents were asked to compare socioeconomic and livelihood vulnerability of the local community before and after the establishment of the national park. According to the response obtained 94% of the respondents were certain that socio-economic vulnerability of the local community is highly reduced after the establishment of the national park. However 3% of the respondents believe the establishment of the national park worsen the situation of the local community.

Table 14: Current and past vulnerability comparison

Vulnerability	**N**	**%**
Increase vulnerability	6	3.0
Reduce vulnerability	191	94.1
No change/as it is	6	3.0
Total	**203**	**100.0**

Source: Computed from survey data, 2017

On the other hand 28.6% of the respondents also believe that the establishment of the national park improve the biodiversity status of the study area and has brought more community advantage in relation with income improvement, job opportunity, socioeconomic institution and infrastructural development and tourism.

Table 15: Benefit of SMNP establishment for local community

Benefit of SMNP	N	Response (%)
Improved biodiversity status and moderate climate change adverse effects	58	28.6
Diversified livelihood options and income	48	23.6
Increased new job opportunities	57	28.1
Improved socioeconomic institutions	40	19.7
Total	**203**	**100.0**

Source: Computed from survey data, 2017

According to table 15, respondents of the study believe that the establishment of the national park with the objective of biodiversity conservation not only helpful to improve the status of the biodiversity but also it helps to diversify local livelihood options and income sources of the community, create new job opportunity in relation to tourism, improve the socioeconomic institutions and infrastructural development and help to moderate adverse climate change effects. In this study 51.7% of the respondents mentioned that because of SMNP local livelihood options improved and new job opportunities created and therefore the income from tourism and related services increase from time to time. In addition to this, 19.7% of the respondents mentioned that socio-economic institutions such as school, health institutions, community lodges, hotels, and other have been constructed to provide services for international, national tourists and local community. This helps to reduce human influence on the national park and biodiversity status improved relatively when compared to other areas outside the national park.

4.2 Estimation and Discussion of Econometric Results for Choice Experiment

In this section the econometric results of the analysis such as basic multinomial logit model, extended multinomial logit model, random parameter logit model results and willingness to pay, and aggregate welfare change were discussed in detail.

Fauna and Flora is the numbers and status of fauna and flora species as well as their habitats in and around SMNP.

Ecosystem services are the amount of environmental resources and numbers of ecosystem services obtained from the area are some of the benefit of biodiversity of the study area. The

amount and use of biodiversity in the study are determined by availability and accessibility of ecosystem services for local community domestic use (for human and livestock water, grazing, agricultural production and productivity, climate regulation etc), direct use, sources of income from sale, accessibility of resources for local community, water sources for downstream users and hydraulic electric etc. It is measured in terms of the number of seasons with water, direct use of forest, climate regulatory services etc.

Tourism facilities and infrastructural development SMNP ecosystem has been one of the potential destinations for both local and foreign tourists. In and around SMNP, tourism has been used as one of the important income sources and one of the major livelihood options for the local community. Therefore the development and improvement of tourism services are key to increase number and satisfaction of tourists which has direct linkage with the income generated from the sector. In addition to this, the development of recreational quality of the site such as infrastructure, hotels (lodges), resting facilities, information facilities etc are crucial in order to attract tourists. The local community can obtain benefits from these improvements directly or indirectly including creation of new job opportunities, direct income generation in case of different fees.

Monetary payment is annual payment for the enhancement and management of ecosystem in and around SMNP (as annual tax or new introduction of fee for conservation).

4.2.1. Multinomial Logit Models

In this section, the results of both basic and extended multinomial models have been discussed in detail.

4.2.1.1. Result of Basic Multinomial Logit Model (MNL)

The estimated result of basic multinomial logit model in Table 16 shows that all the attributes namely fauna and flora, ecosystem services, tourism facilities and infrastructural development, and monetary payment/conservation fee are highly significant at 1% level and their sign is positive except WTP which is negative as expected.

The base category for this study is status quo. In this study, Alternative Specific Constant (ASC) has been used to reflect the base category. ASC take value 1 for the attributes with changes and/or improvement plan ($plan_1$ and $plan_{2)}$ in the choice sets, and 0 for the base (status quo) option.

Table 16: Basic Multinomial Logit Model Result

Variable	Coefficient	Standard Error
ASC	1.83***	0.41
WTP	-0.04***	0.00
FAUNAF	0.87***	0.19
ECOSYS	1.07***	0.20
TOURMFA	0.94***	0.20
SUMMARY		
Log-likelihood		-570.34
Pseudo R^2		0.12
Number of Observations		1015

*** Significant at 1%; ** significant at 5%; * significant at 10%

Source: Computed from survey data, 2017

The result of the above basic multinomial logit model (MNL) revealed that all the attributes are highly important in determining biodiversity improvement and management of the study area. This mean that an increase in the level of these attributes will definitely increases the probability of choosing improved scenario which implies that improvement of positive attributes leads to improved utility of the respondent along with the respective attribute improvement scenario.

It is clear that the respondents gave high weight for all attributes and their improvement plan. This may be the respondent has good know how about the importance of fauna & flora, ecosystem services and tourism facility and infrastructural development and the direct and indirect benefit which they can obtain from the improvement plan of these attributes.

As good example respondents especially these who live inside the 38 SMNP bordering KAs benefited from tourism facilities and infrastructural development in many ways. In addition to this, if these improvement plans are implemented successfully, income from tourism services will increase, new created job opportunities for local communities, socioeconomic institutions will be constructed which can be used by local communities in addition to the tourist, like access to all season road, hotel and lodge services etc. On top of this, the downstream and other people outside the buffer zone will benefit from ecosystem services which they obtain from improved biodiversity at all level. Thus, an improvement in these positive sign attributes increases the probability of choosing the improved alternative scenario with higher level of these attributes, citrus paribus.

The sign of conservation fee/monetary attribute/ is negative as expected and significant at 1% level. This implies that respondents are against for the higher payment level in the alternative scenario, other things kept constant. An alternative scenario with higher payment level was not preferred by the respondents mean respondents' utility was low for such alternative scenario. The alternative specific constant (ASC) has positive sign and it is significant at 1% level which implies that there is welfare improvement as we choose improved scenario from status quo.

4.2.1.2. Result of Extended Multinomial Logit Model

The extended multinomial logit model was estimated with the interaction of socioeconomic co-variants with ASC. The objective of this estimation is to see the effect of socioeconomic co-variables on the model.

Table 17: Extended Multinomial Logit Model

Variable	Coefficient	Standard Error
ASC	3.48***	0.57
WTP	-0.02**	0.01
FAUNAF	1.00***	0.20
ECOSYS	1.13***	0.20
TOURMFA	1.06***	0.20
ASC*SEX	-0.16	0.20
ASC*AGE	-0.05***	0.01
ASC*FAMSIZE	-0.04	0.09
ASC*NUMDEPS	-0.12	0.11
ASC*EDUC	-0.10**	0.03
ASC*INCOME	-0.32	0.87
ASC*NOLIVEST	0.00	0.01
ASC*DISKM	-0.14**	0.05
SUMMARY		
Log-likelihood		-385.75
Pseudo R^2		0.4
Number of Observations		1015

*** Significant at 1%; ** significant at 5%; * significant at 10%

Source: Computed from survey data, 2017

The estimation result of the extended multinomial logit model shows that except the slit improvement of monetary attribute/WTP the other attributes have the same result like that of the basic multinomial logit model. All attributes are highly significant at 1% level.

The coefficient of the interaction of ASC with the socioeconomic and demographic characteristics of age, education and distance are significant at 1% level. However, family size, number of dependent, and number of livestock are not significant though their sign is as expected.

As the extended multinomial logit model result shows age is significant at 1% level but with negative sign. This is because 66.5% of the respondents for this study were under middle[5] age level and 10.3% respondents were at higher age level. It was expected that the younger the person will become less responsible for biodiversity conservation and unwilling to pay for biodiversity improvement plans. However, according to the result of the table above it was the reverse the older people have been found uninterested and unwilling to pay for biodiversity improvement plan mean that the probability of choosing improved plan is less than the probability of choosing status quo.

Table 18: Age Category of Respondents

Age Category	N	Response %	Age Level
18-30	47	23.2	Young
31-40	75	36.9	Middle
41-50	60	29.6	Middle
51-60	21	10.3	Older
Total	203	100.0	

Source: Computed from survey data, 2017

Likewise education co-variant is significant at 5% level with negative sign. This shows that as 31.5% of respondents are illiterate it can be concluded that in the rural area most of the interviewed people are illiterate, that is why education coefficient is negatively correlated. This means that the more illiterate the local communities are they become unwilling to pay for improvement plan which was as expected. This is because increased number of years of education can improve the knowledge and understanding of the local community and they became aware of the importance of biodiversity.

[5] Middle age level is 30-50

Other socioeconomic and demographic co-variants (Family size, Number of dependents, Income and number of livestock) are negative and insignificant even at higher significant level. This implies that the interaction of these variables is not a significant factor in affecting the probability of choosing the improvement plans.

According to the result in table 17, distance from the national park is significant at 1% level with negative sign as expected. This shows that people living near to the national park are willing to the improvement plan than people who live far from the national park. This is because most of time peoples near tot the national park are highly dependent on the national park and its buffer zone for ecosystem services and resources of the park. In addition to the ecosystem services, a person who lives near to the national park is benefited from socioeconomic institutions, tourism services and others. Thus, they will become willing to pay for improvement plan and the probability of choosing improvement plan is higher than people far from the park, citrus paribus.

Like the basic multinomial logit model result ASC was positive and significant which shows that there was welfare improvement in choosing the improvement plan.

The overall explanatory power of the model was assessed using McFadden's Pseudo R^2. According to Birol *et al*., (2005), when the value of R^2 is between 0.2 and 0.4, the model is said to be good fit. For this study the values of Pseudo R^2 for basic MNL and extended MNL were 0.12 and 0.4, respectively. In this case the inclusion of the socioeconomic variables highly improves the explanatory power of the model and the extended MNL become highly adequate than the basic multinomial logit model.

4.2.2. Random Parametric Logit Model (RPL)

The random parameter logit was estimated to address the unobserved preference heterogeneity and possible violation of the independence of irrelevant alternatives (IIA) assumption.

According to Alpizar *et al*., 2001, multinomial logit model has two major problems. The first problem is the assumption of the Independence of Irrelevant Alternatives (IIA) which may not hold. Mean that the IIA property which is the result of independently and identically distributed (IID) assumption states that the ratio of choice probabilities between two alternatives in a choice set is unaffected by other alternative changes in that choice set. This is to mean if we add or remove new alternative scenario over the existing one, the choice

probability of the first alternative scenario will not be affected. The second problem is though the observed heterogeneity can be incorporated in the model by interacting the socioeconomic characteristics with the attributes or ASC, MNL doesn't take into account the test variation or unobserved heterogeneity among individual respondents. Thus, RPL is used to incorporate the unobserved heterogeneity. It was unable to undertake the hausman test to find out whether the IIA assumption is violated in the multinomial logit model as the difference matrix was negative definite. But RPL model result is presented in table below which is believed to address the two problem of MNL.

Table 19: Result of Random Parameter Logit Model

Variable	**Coefficient**	**Robust Standard Error**
ASC	5.80***	1.29
WTP	-0.01**	0.00
FAUNAF	0.92***	0.19
ECOSYS	1.02***	0.20
TOURMFA	0.98***	0.20
SUMMARY		
Log-likelihood		-354.57
Pseudo R^2		0.45
Number of Observations		1015

*** Significant at 1%; significant at 5%; significant at 10%

Source: Computed from survey data, 2017.

The above estimated result of the random parameter logit model shows that the sign and significance level of the coefficients is similar like that of the result of multinomial logit models. However, there is some improvement in the magnitude of coefficient for the monetary payment/WTP attribute. The four attributes in this model are significant at 1% level. The random parameter logit model explanatory power which is given by the level of pseudo R^2 is 0.45 which is highly improved and it is better while the corresponding value of

multinomial logit model is 0.4. Thus, there is an improvement in the model fit in using RPL for the data set.

4.2.3. Estimation of the Marginal Willingness to Pay

The implicit price or marginal willingness to pay is the marginal rate of substitution between the three biodiversity attributes and monetary attributes (Ali, 2011). It is the rate at which respondents are willing to pay for the improvement of an attribute. The value of the implicit prices of different attributes revealed that the relative importance of the attributes for the society (Ali, 2011). The value of the implicit prices/part worth of different attributes can tell us the relative importance of each attribute for the society and/or target population. The value of the marginal willingness to pay can be calculated using the ratio of the coefficient for the attributes of biodiversity in random parameter logit model to the coefficient of the negative inverse of monetary attributes.

The result of marginal willingness estimated value below revealed that respondents gave high weight to ecosystem services than other attributes. This is because most of the respondents are rural community who dependents on natural resources and ecosystem service obtained from the ecosystem.

Table 20: Marginal willingness to Pay (MWTP)

Variable	MWTP	Standard Error	P[|Z|>z]
Fauna and flora	61.82	0.12	.0000***
Ecosystem Services	68.56	0.12	.0000***
Tourism Facilities and Infrastructural Development	66.03	0.13	.0000***

Source: Computed from survey data, 2017

In table 20 it can be observed that the implicit price for all attributes are positive and significant at 1% level, which implies that respondents have a positive WTP for an increase in the quality or quantity of each attributes.

According to the result the respondents are willing to pay 68.56 birr for ecosystem service improvement plan which is the highest payment. The local community also is willing to pay 66.03 birr per year for tourism facilities and infrastructural development improvement scenario. This is because the local community in general and people who live around the

national park in particular know how tourism services can generate income and livelihood opportunities for the local community. Thus, those who know more about the importance of tourism are highly willing to pay for this improvement plan. Respondents are also willing to pay about 61.82 birr for an increase in the level of fauna and flora, cirrus paribus. This is not meant that the local community is not willing to pay for the improvement plan of fauna and flora attribute; however, they prefer other attributes more than fauna and flora.

Even though respondents are willing to pay different amount for each attributes, the result of the estimation revealed that respondents believe all the attributes are important given the importance level of each attributes as it is.

4.3. Estimation of Welfare Measures and Economic Value of Biodiversity

One of the strength of using Choice Experiment evaluation method is that the estimated coefficients of the attributes enable to estimate the value of different scenarios from one application (Bennet and Blamey, 2001). This means that from one set of the choice data, the values of different alternative scenarios can be estimated. Economic welfare measurement involves an investigation of the difference between the utilities of the individuals that could be achieved under the status quo and changed scenario alternatives which is computed by using equation (10). Welfare measures can be estimated using the parameter estimates of the RPL model and values (levels) of the attributes. To compute, first, the values of the attributes in the status quo alternatives are substituted into the indirect utility function. Next, the values of the attributes in changed situation of scenarios are substituted into the indirect utility function. The value of the alternative with a changed situation is, then, subtracted from the value in the status quo alternative and finally multiplying this by the negative inverse of the coefficient of the monetary attribute (Getenet, 2012).

In this paper, the following three alternative scenarios have been used to illustrate the overall WTP for improvements with respect to the status quo:

Current situation of biodiversity in the study area

- Currently the number of fauna and flora is highly reduced and their habitat is highly degraded which needs to be improve. No increase in the number fauna and flora and their habitats,
- Ecosystem services obtained from the national park and the ecosystem in general reduced because of degradation,

- The tourism services are poor and low quality and there are no new development of infrastructures in and around the national park,

Based on the above current situation, the following improvement plans have been considered in this study

1. Improvement scenario 1 (High impact improvement scenario)

- 50 %increase in the number and status of fauna and flora and their habitats,
- Improvement of all ecosystem services
- Improvement of all tourism services (quality and quantity) and infrastructural development

2. Improvement scenario 2 (Medium impact improvement scenario)

- 30 %increase in the number and status of fauna and flora and their habitats,
- Improvement of only some important ecosystem services
- Improvement of few tourism services (quality and quantity) and some infrastructural development

3. Improvement scenario 3 (low impact improvement scenario)

- No improvement plan in the number and status of fauna and flora and their habitats,
- No improvement of ecosystem services
- No improvement for tourism services and no new development of infrastructural facilities

Table 21: Willingness to Pay for each Alternative Improvement Scenario

Alternative improvement scenarios	Annual WTP (Birr)
High impact improvement scenario	587.03
Medium impact improvement scenario	391.62
Low impact improvement scenario	195.41

Source: Computed from survey data, 2017

The above estimated result shows that there is welfare change because of the improvement from status quo situation. The result also tell us that the local community willingness to pay increases when the status of biodiversity improved in the study area**.** The local communities are willing to pay 587.03 Birr annum for high impact improvement scenario and 391.62 and 195.41 Birr for medium and low impact improvement scenarios, respectively. The respondent's willingness to pay for improvement scenarios increases from low impact

improvement scenario to high impact improvement scenario. This is because all attributes are generally important but ecosystem services attribute is highly important for the respondents. This estimated result also revealed that respondent is willingness to pay for biodiversity improvement and management plans whatever the level of improvement may be.

The overall annual economic value/welfares of biodiversity in and around SMNP (the aggregate willingness to pay) for improvement plans (low, medium and high impact improvement scenarios) are 7,926,806.65, 15,886,086.30 and 23,812,871.95 Birr per year, respectively. This aggregate willingness to pay has been obtained by multiplying annual WTP by total HHs (40565HHs). This value doesn't reflect all the value of biodiversity for the local, regional and global community obtained from SMNP. This is just a value of biodiversity in and around SMNP for only local community.

4.4. Analysis of the Results of the Follow up Questions

To know exactly the reason why respondents made their choices in responding the choice set exercise six follow up questions that best describe the reason why made their choice were presented to respondents. Table 22 shows that the result of follow up questions

Table 22: Follow up Questions

Follow up Questions	N	Response (%)
The proposed measures were good but I didn't have the ability to pay and thus I chose the status quo	24	11.8
I chose the status quo option because of an objection to the amount of conservation fee	9	4.4
I exclusively chose the cheapest plan whatever its levels	15	7.4
I found that the improvement of biodiversity/fauna and flora attribute is important and thus gave a priority for choice the highest level of this attribute	44	21.7
I found that ecosystem service attribute is important and thus gave a priority for choice the highest level of this attribute	60	29.6
I found that improving the tourism services attribute is important and thus gave a priority for choice the better of this attribute	51	25.1
Total	**203**	**100.0**

Source: Computed from survey data, 2017

The result of the above table reveals that respondents' choice is highly harmonized with the choice they made in the estimation of the multinomial and random parameter logit model. The highest weight was given for ecosystem services and the next best to tourism facilities and infrastructural development followed by fauna and flora improvement plan. Likewise in the follow up question the highest weight was given to ecosystem improvement plan.

In this study, 29.6% of the respondents replied that they gave top priority for the highest level for the attributes of ecosystem services. This is because most of the respondents are rural community who depend on natural resources and ecosystem services obtained from the ecosystem of Simien Mountains National Park. The next best weight was given for the improvement of the tourism services facilities and infrastructural development attribute. According to the result of the above table, 25.1% of the respondents replied that the improvement in tourism facilities and infrastructural development attribute was relevant and choose the alternative that includes the highest level for this attribute. It is clear that the local community is benefiting from tourism services directly or indirectly. In addition to the income and job opportunities the local community also benefit the socioeconomic institutions constructed for the tourism service improvement. On the other hand, 21.7% of the respondents choose fauna and flora improvement plan with its highest level. Significant number of respondents, 11.8%, chooses the status quo options whatever the levels of the attributes since they are unable to pay for future costs of improvement. Based on the result of the above table, 7.4%of the respondents chosen the cheapest plan whatever the level of the attributes. The result also revealed that 4.4% of the respondents replied that they made choice of status quo because of the objection of the amount conservation fee/payment.

5. SUMMARY, CONCLUSION AND RECOMMENDATION

5.1. Summary and Conclusion

In this paper, the economic value of biodiversity for local livelihood was estimated using non-market valuation method, choice experimental valuation method. This study is an essential basis for biodiversity valuation studies in the study area in particular and in the country in general if it provides meaningful information for decision-making processes regarding biodiversity conservation and proper resource utilization.

In this study, value of biodiversity was estimated using both multinomial logit models and random parameter logit model. The estimated result revealed that all the biodiversity attributes were found significant which revealed that the probability of choosing biodiversity attributes with higher level improvement plan is high. The estimated marginal willingness to pay result revealed that respondents are willing to pay for all attributes; however, they gave more value for the ecosystem service attribute followed by tourism facilities and infrastructural development attribute. The weight given to ecosystem attributes shows that the local communities' preference for this attribute is higher than other attributes.

In addition to the willingness to pay, the estimated welfare measures under different scenarios revealed that the welfare (wellbeing) of the society improves while there is improvement in the different attributes.

While this study was not designed to look into details of biodiversity loss and driving forces, the result show that there is high degradation of biodiversity due to human induced problems. Due to this high degradation of biodiversity, the local community is affected regarding food security, climate change effect, reduction of agricultural production and other multifaceted development challenges. However, the establishment of SMNP reduce the vulnerability of the local community when compared to the socioeconomic and livelihood vulnerability before and after the establishment of the park.

Generally, the proposed biodiversity valuation method enables to estimate the value attached to each attributes and to estimate the willingness of the local community. In addition to this, it helps to calculate the aggregate welfare change of the local community. The result has policy implications for planning appropriate biodiversity improvement plan in general and to characterize biodiversity attributes based on the coefficient attached to it.

5.2. Recommendation

This paper contributes to the literature on estimation of economic value of biodiversity of SMNP using choice experiment valuation method and it is the first type of study on economic valuation of biodiversity that have been undertaken in the study area using choice experimental valuation method.

The result of the study revealed that, biodiversity of SMNP plays significant role for the welfare improvement of the local community in particular and has global significance in climate change in general. In this study respondents have been found willing to pay for the improvement of biodiversity of the national park and its buffer zone. Even though the weight given to ecosystem service attribute is higher than other attributes, the societies are also willing to pay for all attributes.

This can be a positive signal to governmental and non-governmental organizations to mobilize the local and international community to generate resources for the purpose of biodiversity improvement and proper management of the environmental resources by improving these attributes.

As the study result revealed that respondents were highly willing to pay for ecosystem services than other attributes of biodiversity. This indicates that respondents are dependent on the natural resources directly or indirectly. Thus, it is much better to give due attention for such indicator otherwise environmental degradation can be aggravated and the vulnerability of the local community will become worsen. Therefore, to reduce the negative effects of the community and minimize environmental degradation, the park's buffer zone may be systematically classified into three zones regarding grazing as it is one of the ecosystem services that the local community uses. Therefore, it is possible to have free grazing area, restricted grazing area and prohibited grazing (cut and carry) areas in the buffer zone. This might be listed in the land use policy papers, but it can be witnessed it is not implemented at all. Therefore, enhancing community awareness and law enforcement might enable to reduce biodiversity loss in the area. This can help to manage the resource and protect the national park as much as possible. However, this should be done with the conscience and consultation of the local community.

It is also equally important to give due attention for tourism facility improvement and infrastructural development so as to enhance the flow of domestic and foreign tourists to the national park and hence it can raise the revenue that can be generated from tourism. The local

community uses tourism as one of the livelihood options and it accommodates significant number of the local community especially youths and unemployed rural community members. Therefore, improving tourism facilities and enhancing infrastructural development can not only help to increase the flow of tourists and diversify job opportunities but also the local community can benefit from the institutions directly or indirectly. This mean that due to increased number of tourists, income from the services increases which can help the local community to reduce their dependency on biodiversity in one hand and the status of biodiversity will improve on the other hand.

- Generally concerned authorities and policy makers shall give due attention in: Designing appropriate conservation and management plan for biodiversity by improving these attributes,
- Mobilizing the local and international community to generate fund/income for conservation. Especially the result of willingness to pay shows that respondents were found willing to pay for all attributes, thus, it is much easier for concerned bodies to generate significant amount of resources for conservation and rehabilitation,
- Improving tourism facility attributes can help to enhance livelihood of the local community, increase flow of tourists, and able to properly manage the resources at the same time. Therefore, it is highly recommended to improve quality and quantity of tourism services, develop tourism facilities and capacitate institutions for the betterment of the sector.
- The study result shows that biodiversity has irreplaceable economic value for the wellbeing improvement of the society. Thus, it is advisable to take action in improving the status of biodiversity for the sake of welfare improvement of the society in particular and for its significant value of the global community in general.

Therefore, conservation and management of the biodiversity of SMNP is vital not only for protecting the world heritage but also for its significant values for local, regional and international community in sustaining development and averting climate change adverse effects.

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APPENDIX

Choice Experiment Interview Schedule

UNIVERSITY OF GONDAR COLLAGE OF AGICLTURE AND RURAL TRANSFORMATION DEARTMENT OF AGRICULTURAL ECONOMICS

Choice Experiment Interview Schedule prepared for the economic value of Biodiversity for local livelihood in and around SMNP, North Gondar Zone, Ethiopia.

This questionnaire has been designed by Misganaw Eyassu who is currently studying in University of Gondar in MSc. In Agricultural Economics to gather primary data from different households to address the objective of biodiversity valuation research conducted for only academic purpose. Most of the local community living in the surrounding districts are highly dependent on the income generated from Agriculture, tourism, income from sale of natural resources and other nature based income sources.

However, there are no study results which can show how much annual income generated from biodiversity and nature based income sources. In addition to this, the market value of biodiversity and natural resources are not clearly known as most of the household collect resources from the national park and consume at household level. Not only the market value but also the contribution and role of biodiversity for local livelihood is not clearly know in and around the protected areas of Ethiopia.

Thus the objective of this research is to estimate the value and role of biodiversity for the local livelihood option in and around the national park. This interview has no any purpose without academic purpose and has no any linkage with the tax and land authorities.

So please fill free to tell anything related with the intended title which you think is important in estimating the value of biodiversity in enhancing biodiversity conservation and improving livelihood of the local community.

Thank you in advance for your time and willingness to provide the required information about the stated issues listed below.

A. Socio-economic and demographic General Questions

Respondents code ---------- (to be completed/given by enumerators which can be started by KA name and 001, 002, etc e.g AJ001: Argenjona 001)

1. Respondents Address (Optional): Address of the respondent: Zone ----------District ---------- Kebele ---------- Village ----------
2. Distance from the national park? ---------- (It can be expressed by time it takes to travel from residence to the national park)
3. Sex of respondents
   1. Female 2. Male
4. Family size, how many people live in the house (Number of Household members)?
   1. 1-2 2. 3-5 3. >5
5. Number of dependents in the household (<13 and >60)?
   1. 2 2. 3 3. 4 4. 5 5. >5
6. Age of respondents ---------- years?

   1. 18-30 2. 31-40 3. 41-50 4. 51-60 5. >60
7. Marital status
   1. Single/Unmarried
   2. Married
   3. Divorced
   4. Widow
   5. Separated
   6. Other (e.g. cohabitation without marriage) please specify ----
8. Religious
   1. Christian (Orthodox)
   2. Christian (Protestant, Jehovah, Catholic etc)
   3. Muslim
   4. Pagan
   5. Other Please specify ---------
9. Education
   1. Illiterate 2. Read and write 3. Primary education (1-4)
   4. Elementary (5-8) 5. Secondary (9-10) 6. High school (11-12)
   7. Certificate 8. Diploma 9. Degree
   10. > Degree
10. What is your occupation?
    1. Agriculture/Farming (Specify) 2. Trading 3. Tourism (Specify)
    4. Government Employee 5. Non-governmental organizations including private sectors 6. Others (Specify) ----------

11. Major income sources of the household?

1. Agriculture
2. Tourism
3. Trade (Please specify) ----------
4. Off- Farm Activities (Please specify) ---
5. Sale of natural resources (Charcoal, Fire wood, other)
6. Remittance
7. Other (Specify) ----------

12. Household land holding (Land size) current land size of the household

1. 0-0.5 Ha
2. 0.5-1 Ha
4. 1.5-2 Ha
5. >2 Ha

13. Household land holding (Land size) before and after the gazetting of SMNP, is the size reduced?

1. Yes 2. No

14. If your answer for QN 13 is yes, by how much?

1. 0-0.5 Ha 2. 0.5-1 Ha 3.1.0-1.5 Ha 4. 1.5-2 Ha 5. >2 Ha

15. Annual average household income in birr (from all income means)

1. < 5000
2. 5000-10000
3. 10000-15000
4. 15000-20000
5. 20000-25000
6. 25000-30000
7. >30000

B. <u>Biodiversity Perception, it importance and local livelihood related questions</u>

16. Do you know about biodiversity?

1. Yes 2. No

17. If yes, tell us anything you know about biodiversity and its role? ----------
---

18. Do you know about the importance of biodiversity?

1. Yes
2. No

19. If yes what are the importance of biodiversity?

1. Biodiversity is a sources of ecosystem services,
2. It is sources of income and household energy,
3. It is important as a sources of medicinal plants and other values,
4. Important for its food and other values?
5. Important to reduce poverty though livelihood improvement,
6. Important for climate regulation,
7. Important for agricultural production improvement,

8. Important for its recreational value,
9. Important to enhance tourism,
10. Other ----------

20. Where do you get this knowledge?
    1. From KA workers such as Development Agents,
    2. From radio and other information sources,
    3. Trained at FTC by district and KA experts,
    4. Trained by NGOs and other organization at district and kebele level,
    5. Obtained from colleagues who trained by other organizations,
    6. other

21. Do you think biodiversity has direct benefit for household?
    1. Yes 2. No

22. If yes, what benefits you get from biodiversity?
    1. Forest product 2.Feed for domestic animals
    3.Food 4.Fire wood
    5.Water for human domestic animals 6.Medicinal plants
    7.Others (specify)----------

23. How often you use ecosystem services?
    1. Never at all 2. Seldom 3. Frequently 4. Other

24. Is biodiversity considered as sources of income in the local area?
    1. Yes 2. No

25. If yes for Q 27, how do you evaluate the income from biodiversity?
    1. Satisfactory 4. Excellent
    2. Good 5. I don't know
    3. Very good 6. Others please specify ----------

26. If yes how much of your income generated from natural resources related income sources? (or it can be expressed in monetary values)
    a. 1-3% b. 3-5% c. 5-7% d. 7-10% e. >10%

27. Who use or dependent on biodiversity more?
    1. Poor of poor 4. Rich
    2. Poor 5. I don't know
    3. Medium

28. Is the income from biodiversity increased or decreased?
    1. Increased 2. Decreased

29. If the answer for Q.No. 31 is decreased, why?
    1. Biodiversity loss,
    2. Protection of biodiversity improved,
    3. Knowledge of the local community increased,
    4. Law enforcement improved,
    5. Alternative income improved instead of using biodiversity,
    6. Other (specify)----------
30. If your answer for QNo 31 is increased why?
    1. Income from tourism increased,
    2. New livelihood option creased as biodiversity improved,
    3. Agricultural productivity improved as soil and other degradation reduced,
    4. Sale of forest products increased,
    5. Access to ecosystem services improved such as grass for livestock, and other natural resources,
    6. Other (specify) ----------
31. What is the status of biodiversity in your district?
    1. Improved,
    2. Degraded,
    3. As it is, No change
    4. I don't know,
32. If your answer for QNo 34 is degraded, what are the causes of biodiversity loss in your district?

S.No	Causes	Strongly Agree (4)	Moderately Agree (3)	Agree (2)	Neither (1)	Disagree (0)
1	Human intervention /pressure of increased population, agricultural encroachment etc					
2	Deforestation					
3	Overgrazing					
4	Natural hazards					
5	Wildfire					
6	Other					

33. How much the local community affected by biodiversity loss?

1. Highly 2. Moderately impacted 3. Minimum impact 4. Not impacted 5. I don't know

34. What are the negative impacts of biodiversity loss?

S.No	List of impacts	Strongly Agree (4)	Moderately Agree (3)	Agree (2)	Neither (1)	Disagree (0)
1	Reduced production and productivity in Agriculture					
2	Adverse climate change					
3	Loss and/or reduction of ecosystem services and aesthetic values of biodiversity					
4	Increased cost of conservation, input purchase etc					
5	Others					

35. How the local community mitigate/cope up negative impacts of biodiversity loss?

1. Changing livelihood options from agriculture to other?
2. Use natural resources as means of income and food,
3. Engaged on alternative income sources,
4. Rent out their land,
5. Work for others as a daily labourer ,
6. Migrate to other places,
7. Depend on PSNP support and other aids,
8. other (specify) ----------

36. What are alternative livelihood options in your district?

1. Small trading,
2. Tourism,
3. Service provision,
4. Fattening, beekeeping, others,
5. Other (specify) ----------

C. <u>Simien Mountains National Park Related Questions</u>

37. How far your residence from the national park? ----------(It can be expressed by time it takes to travel from residence to the national park)

38. How Simen Mountains National Park is related to you or your life?

1. Have no any relation

2. Have relation in one way or another

39. If your answer for QNo.39 is 2, how often you go to the national park and its buffer zone?

1. Frequently 2. Seldom 3. Never at all 4. Other

40. If your answer for Q No. 39 is 1 or 2 for what purpose do you go to the national park?

1. For farming since the farm land is inside the national park
2. For animal grazing since the grazing land is inside the national park
3. To collect different forest products for household consumption
4. To collect different forest products for sale
5. For hunting
6. For Recreation
7. To Work as scout, local militia, local guide, Cook,
8. For Mule rent services,
9. Other please specify ----------

41. Do you think the establishment of the national park affects you?

1. Yes (Negatively affected) 2. No (have positive impact)

42. If your answer for QNo 44 is yes? What are the negative impacts?

S.No	List of impacts	Strongly Agree (4)	Moderately Agree (3)	Agree (2)	Neither (1)	Disagree (0)
1	Reduced farm land					
2	Reduced free grazing /pasture					
3	Restricted access to ecosystem services					
4	Increased attack of wild mammals (increased human wildlife conflict)					
5	Others					

43. If your answer for QNo 44 is No, what benefits (positive impact) the local community obtain?

S.No	List of impacts	Strongly Agree (4)	Moderately Agree (3)	Agree (2)	Neither (1)	Disagree (0)
1	Increased job opportunities for local					

	community					
2	Improved biodiversity status and moderate climate change problems					
3	Increased income from tourism					
4	Increased availability of ecosystem services for downstream					
5	Others					

44. How do you compare current socioeconomic and livelihood vulnerability compare to past socioeconomic and livelihood vulnerability of the local communities?

1. Increase vulnerability 2. Reduced vulnerability 3. No change 4. I don't know

45. If reduced vulnerability how?

1. Improved biodiversity status and moderate climate change adverse effects
2. Diversified livelihood options and income
3. Increased new job opportunities
4. Improved socioeconomic institutions,
5. Others please specify

D. Experimental Choice Design

Interviewer: Now read the Choice Scenario to your respondents. Make sure that they pay attention of your description

The Choice Experiment Scenario

In this experiment the aim is to give short description about the choice set that will be provided and to investigate respondent's choices for various measures affecting biodiversity of the park and its buffer zone in terms of the fauna and flora status, ecosystem services, tourism and tourism facilities development and other conservation measures. Here, we ask you to consider these factors and the costs for carrying out various measures in the choice questions that follow. But for the questions that follow, no 'wrong' or 'correct' answers are expected. What is required is the priority that you place for the different options/plans provided and asked you to choose your preferred option. Please! Be careful in considering the attributes: *fauna and flora, ecosystem services, and tourism and facilities, a*ssume that the levels of these attributes are independent to each other. Please mark the preferred plan as if it is the only choice you make. In case you change your mind, feel free to go back and change your previous choice(s).

Suppose the government has an intention to take measures that could mitigate the problems of the biodiversity degradation in and around the national park and reassure the development, conservation and sustainable use of the resources of the park and its surrounding. In order to accomplish this, there are fundamentally three areas where the government plans to improve the biodiversity status of the park and its services. These are:

1. Fauna and Flora improvement: This program is designed in response to the decline of wild life species (both fauna and flora) particularly endemic wildlife such as Walia ibex, Ethiopian Wolf and other mammals such as Gelada Babon, Minilik Dikula, Lamarger etc. Thus, the plan is to improve the numbers and status of fauna and flora species as well as their habitats in and around SMNP especially endangered wildlife such as Walia Ibex and Ethiopian Wolf through establishing wildlife corridors, enlarging the core area, establishing buffer zone, reducing over grazing, improving law enforcement, reforestation with indigenous trees, and other conservation measures such as soil and water conservation physical structure construction, biological SWC etc.

2. Ecosystem Services: This plan is designed to solve the problem of decline the amount of environmental resources and numbers of ecosystem services obtained from the ecosystem due to human induced problems such as agricultural encroachment, deforestation, overgrazing, and other problems. Due to this problem availability and accessibility of ecosystem services for domestic use reduced. This program involves afforestation of the landscape, undertaking conservation and rehabilitation works on degraded areas, and conserving the existing biodiversity cover. Thus, this program helps to improve the status of biodiversity and enhance watershed restoration process and park quality in terms of restoring the biotic contents (like different kind of endemic birds and wildlife) of the area. Moreover, this programme improves water resources and other ecological and hydrological functions for both the downstream population and others

3. Tourism and facilities: This program is designed to improve tourism services and different facilities including infrastructure and other for tourists with the aim of improving income from tourism. Thus, this program designed to be implemented though infrastructural development, tourism service enhancement and improving all the facilities based on the standards and interests of the tourist. Therefore the development and improvement of tourism services are key to increase number and satisfaction of tourists which has direct linkage with the income generated from the sector. Thus, the development of recreational quality of the site such as infrastructure, hotels (lodges), resting facilities, information facilities etc can increase tourist satisfaction and then income from tourism; thus, it will be a reliable income sources for the local community.

However, all these plans require money and considerable efforts to be implemented as planned. To implement these programmes for the betterment of the environment, concerned authority will design alternative strategies. In addition to this, the local community, international community, and other organizations will be charged with some amount of money in the form of tax for community and conservation fee for others (tourists and other organizations). This payment will help the government to improve participation of the local community in conservation, improve infrastructure and facilities which enhance quality and quantity of services of the national park.

Assume all these programs will be implemented and planned money will be spent to improve biodiversity status, improve ecosystem, and enhance the quality of the national park in terms of fauna and flora restoration, improving tourism services and tourism facilities and enhancing the existing services.

Interviewer: Now show the Choice Set Cards and explain what they represent. Make sure that they pay attention of your description and help them in clarifying any doubt. Of the three plans below, which one of the following Plans do you prefer for each choice set?

Choice Set 1

Attributes	**Plan one**	**Plan two**	**Status quo**
Fauna and Flora	Medium level improvement of fauna and flora (by 30 %.)	Medium level improvement of fauna and flora (by 30 %.)	No improvement measure
Ecosystem Services	All ecosystem services should be restored	Some ecosystem services that have a direct impact should be restored	No Change
Tourism and facilities	Infrastructural dev't, facilities improvement, services quality should be improved	Infrastructural development and some facilities should be improved	No Change
Monetary Payment	birr 75	birr 75	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Choice Set 2

Attributes	**Plan one**	**Plan two**	**Status quo**
Fauna and Flora	High level improvement of fauna and flora (by 50%).	Medium level improvement of fauna and flora (by 30 %.)	No improvement measure
Ecosystem Services	Some ecosystem services that have a direct impact should be restored	All ecosystem services should be restored	No Change
Tourism and recreational facilities	Infrastructural development and some	Infrastructural development and some facilities should	No Change

	facilities should be improved	be improved	
Monetary Payment	Birr 75	Birr 100	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Choice Set 3

Attributes	**Plan one**	**Plan two**	**Status quo**
Fauna and Flora	High level improvement of fauna and flora (by 50%).	Medium level improvement of fauna and flora (by 30 %.)	No improvement measure
Ecosystem Services	Some ecosystem services that have a direct impact should be restored	Some ecosystem services that have a direct impact should be restored	No Change
Tourism and recreational facilities	Infrastructural development and some facilities should be improved	Infrastructural dev't, facilities improvement, services quality should be improved	No Change
Monetary Payment	100 Birr	100 Birr	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Choice Set 4

Attributes	**Plan one**	**Plan two**	**Status quo**
Fauna and Flora	High level improvement of fauna and flora (by 50%).	High level improvement of fauna and flora (by 50%).	No improvement measure
Ecosystem Services	All ecosystem services should be	All ecosystem services should be	No Change

	restored	restored	
Tourism and recreational facilities	Infrastructural dev't, facilities improvement, services quality should be improved.	Infrastructural development and some facilities should be improved	No Change
Monetary Payment	75 Birr	75 Birr	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Choice Set 5

Attributes	**Plan one**	**Plan two**	**Status quo**
Fauna and Flora	Medium level improvement of fauna and flora (by 30 %.)	High level improvement of fauna and flora (by 50%).	No improvement measure
Ecosystem Services	All ecosystem services should be restored	All ecosystem services should be restored	No Change
Tourism and recreational facilities	Infrastructural dev't, facilities improv't, services quality should be improved	Infrastructural dev't, facilities improv't, services quality should be improved	No Change
Monetary Payment	100 Birr	100 Birr	No payment
Choose one by putting a tick mark (√)	**[ ]**	**[ ]**	**[ ]**

Follow up questions for Experimental Choice Model

Which one of the following statements best describes the reason for your choices of the plans?

1. The proposed measures were good but I didn't have the ability to pay and thus I chose the status quo.
2. I chose the status quo option because of an objection to the amount of conservation fee.
3. I exclusively chose the cheapest plan whatever its levels.
4. I found that the improvement of biodiversity/fauna and flora attribute is important and thus gave a priority for choice the highest level of this attribute.
5. I found that ecosystem service attribute is important and thus gave a priority for choice the highest level of this attribute.
6. I found that improving the tourism services attribute is important and thus gave a priority for choice the better of this attribute.

Approval Sheet

UNIVERSITY OF GONDAR

POSTGRADUATE DIRECTORATE

THE ECONOMIC VALUE OF BIODIVERSITY FOR LOCAL LIVELIHOOD IN AND AROUND SIMIEN MOUNTAINS NATIONAL PARK, ETHIOPIA: APPLICATION OF NON-MARKET VALUATION METHOD

Submitted by:

Misganaw Eyassu____ _____ _____
Name of Student Signature Date

Approved by:

1. **Akalu Teshome(PhD)** _____ _____
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2. **Abebe Dagnew (Assistant Prof.)** _____ _____
   Name of Co-Advisor Signature Date

3. _____ _____ _____
   Name of Chairman, DPGC Signature Date

4. _____ _____ _____
   Name of Coordinator, CART PGC Signature Date